



SDMS DocID 2053747

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**FIVE-YEAR REVIEW REPORT**

**LETTERKENNY ARMY DEPOT**

**SOUTHEASTERN AREA**

**NATIONAL PRIORITIES LIST SITE**

**CHAMBERSBURG, PENNSYLVANIA**

**FINAL**



**U.S. Army Corps of Engineers**  
**Hazardous, Toxic, Radioactive Waste Branch**  
**Baltimore, Maryland**

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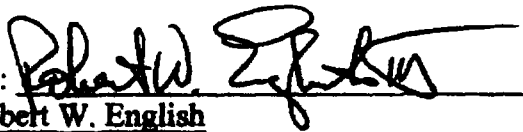
**FINAL**

**Letterkenny Army Depot**  
**Chambersburg, Pennsylvania**

October 2001

This report documents completion of the five-year review for the Letterkenny Army Depot Southeastern Area as required by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) in accordance with CERCLA §121 (c), as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCO), part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR).

United States Department of the Army

By:   
Robert W. English  
Colonel, U.S. Army  
Commanding  
Letterkenny Army Depot

Date: 25 Oct 01

## EXECUTIVE SUMMARY

The first five-year review of the Letterkenny Army Depot (LEAD) Southeastern Area (SE) in Chambersburg, Pennsylvania was completed in September 2001. The review was conducted from July to September 2001 in accordance with the US Environmental Protection Agency (EPA) guidance document titled Comprehensive Five-Year Review Guidance, dated June 2001 (EPA, 2001); this report documents the results of the review. The trigger for this five-year review was based on the implementation of the first remedial action for the Operable Unit (OU) at the SE Area National Priorities List (NPL) Site. This report focuses on the SE OU1, K-Areas.

The remedy for the K-Areas OU included low temperature thermal desorption and stabilization of contaminated soils. The remedial action was completed on September 30, 1995. The trigger for this five-year review was the actual start of construction in August 1993.

Overall, the remedy is functioning as designed, and is being operated and maintained in an appropriate manner. One deficiency was identified during the five-year review (need for institutional controls); however, this deficiency does not impact the protectiveness of the remedy under current conditions. The remedy at the K-Areas OU is protective of human health and the environment under current conditions, and is consistent with the long-term goals for the K-Areas OU. The cap prevents direct contact with soil and is effective at containing contaminants by preventing the infiltration of precipitation. The protectiveness of the remedy is comparable to the level of protectiveness at the time construction of the remedy was completed.

To ensure long-term protectiveness in the future, institutional controls need to be developed and implemented for the K-Areas OU to limit future use of the property and maintain the long-term integrity of the cap.

**Site Identification**

Site Name: OU 1 K Areas, Southeastern Area Letterkenny Army Depot    EPA ID: PA6213820503  
Region: 03                      State: PA                      City/County: Franklin

**Site Status**

NPL Status: Final  
Remediation Status: Ongoing Operation  
Multiple OUs: Yes  
Construction Completion Date: June 2007  
Has the site been put into reuse? No  
Funding Source: ER,A

**Review Status**

Lead Agency: U.S. Army  
Who Conducted the review (EPA Region, State, Federal Agency): Federal Facility  
Author Name: Joe Petrasek  
Author Title: LEAD ER,A Project Manager  
Author Affiliation: U.S. Army  
Review Period :    From: 31 July 2001                      To: 15 September 2001  
Date(s) of Site Inspection: 1 August 2001  
Type of Review: Statutory                      Number of Review: 1  
Triggering Action Event: Remedial Action Start  
Trigger Action Date: 11 August 1993  
Due Date: 11 August 1998

**FIVE YEAR REVIEW SUMMARY REPORT****Deficiencies:**

One substantial deficiency was identified:

- Addition of institutional controls

This deficiency does not currently affect the protectiveness of the remedy under current conditions; however, future protectiveness may be affected if controls are not implemented.

**Recommendations and Follow-up Actions:**

An Explanation of Significant Differences (ESD) will be prepared to implement institutional controls that will restrict the use of the property and protect cap integrity.

**Protectiveness Statement(s):**

The remedy at SE OU 1 (K-Areas) is considered protective of human health and the environment, in the short-term, under current conditions (continued industrial use). To ensure long-term protectiveness in the future, institutional controls need to be developed and implemented. The remedies for the following SE OUs have not been selected at this time:

SE OU 2 (Industrial Wastewater Sewer System)

SE OU 3 (Disposal Area VOC-Contaminated Groundwater)

SE OU 4 (Stormwater Sewer Lines and Associated Drainageways)

SE OU 5 (Areas A and B Contaminated Soils)

SE OU 6 (SE Area Offpost Contaminated Groundwater)

SE OU 7 (Truck Open Storage Area)

SE OU 8 (BRAC Waste Sites)

SE OU 9 (Landfill J)

SE OU 10 (Southern Southeast Industrial Area VOC-Contaminated Groundwater)

SE OU 11 (Northern Southeast Industrial Area VOC-Contaminated Groundwater North of Gate 6)

SE OU 12 (Landfill G)

**Other Comments:**

None

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**LIST OF ACRONYMS**


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µg/kg	micrograms per kilogram
µg/L	micrograms per liter
ARARs	applicable or relevant and appropriate requirements"
BRAC	Base Closure and Realignment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	centimeters
DA	Disposal Area
DAF	dilution attenuation factor
DCE	1,2-dichloroethene
DLA	Defense Logistics Agency
DRMO	Defense Reutilization Marketing Office
dscf	dry standard cubic foot
EE/CA	engineering evaluation/cost analysis
ESD	Explanation of Significant Differences
ESE	Environmental Science and Engineering, Inc.
FFS	Focused Feasibility Study
fixated	exceeded TCLP standards for lead were treated
FOSLs	Findings of Suitability to Lease
FOST	Finding of Suitability to Transfer
ft/day	feet per day
HRS	Hazard Ranking Score
IAG	Interagency Agreement
IC	Institutional Control
IWTP	Industrial Wastewater Treatment Plant
IWWS	Industrial Wastewater Storm Sewers
LDR	Land Disposal Restriction
LEAD	Letterkenny Army Depot
LT <sup>3</sup>	Low Temperature Thermal Treatment
MOA	Memorandum of Agreement
mph	miles per hour
msl	mean sea level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NSIA	Northern Southeast Industrial Area

OBP	Oil Burn Pit
OU	Operable Unit
OU	Operable Unit
PADEP	Pennsylvania Department of Environmental Protection
PADER	Pennsylvania Department of Environmental Resources
PCBs	polychlorinated biphenyls
PDO	Property Disposal Office
PP	Proposed Plan
ppb	parts per billion
RA	Risk Assessment
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
SE	Southeastern Area
SSIA	Southern Southeast Industrial Area
SSL	Soil Screening Level
SVOCs	semivolatile organic compounds
TBC	To Be Considered"
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TPH	total petroleum hydrocarbons
U.S. EPA	U.S. Environmental Protection Agency
USAF	U.S. Air Force
WESTON®	Roy F. Weston, Inc.

## 1. INTRODUCTION

The United States (U.S.) Army, with review and input from the U.S. Environmental Protection Agency (U.S. EPA) and the Pennsylvania Department of Environmental Protection (PADEP) has conducted a five-year (statutory) review of the remedial actions implemented at the OU 1 K Areas, Southeastern Area, Letterkenny Army Depot (LEAD), Franklin County, Pennsylvania. The review was conducted from 31 July 2001 to 31 October 2001.

The purpose of five-year reviews is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in five-year review reports. In addition, five-year review reports identify deficiencies found during the review, if any, and recommendations to address them. The lead agency (U.S. Army) must implement five-year reviews consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA 121(c), as amended states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented.

The NCP part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR) states:

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

There are twelve OUs established for the SE Area NPL Site. This is the first five-year review for the Letterkenny Army Depot, Southeastern Area. The triggering action for this statutory review is the remedial action start date for the SE OU 1—K-Areas, as shown in U.S. EPA's CERCLIS3/WasteLAN database:11 August 1993. Specifically, this five-year review is being activated by the continuing presence of contaminants at the site above levels that allow for unlimited and unrestricted use. In addition, this five-year review discusses the status of the remaining eleven OUs.

## 2. SITE CHRONOLOGY

Table 1 lists the chronology of events for the Southeastern Area site.

**Table 1 Chronology of Site Events**

Event	Date
Initial Discovery	1978
RI/FS Complete	1983
NPL Listing	22 July 1987
Federal Interagency Agreement	3 February 1989
Record of Decision (ROD) Signature	2 August 1991 (K Areas, SE OU 1)
Explanation of Significant Differences (ESD)	2 August 1991 (K Areas, SE OU 1)
Remedial Design Start	25 September 1991 (K Areas, SE OU 1)
RI Addendum Complete	August 1993 (SE OU 2 and SE OU 3)
Remedial Design Complete	14 June 1993 (K-Areas, SE OU 1)
Remedial Action Start	11 August 1993 (K-Areas, SE OU 1)
Remedial Action Complete	30 September 1995 (K-Areas, SE OU 1)
Removal Actions	1994-1995 (IWWS Emergency Repairs, SE OU 2) August 1996 (SE OU 2, SE OU 4) March 1997 (SE OU 5, SE OU 7) December 2000 (SE OU 7) July 2001 (SE OU 9)

### 3. SITE BACKGROUND

LEAD is located (see Figure 1) on the Western side of the Cumberland Valley, in the central part of Franklin County, 5 miles North of Chambersburg, PA. The Depot fronts on Pennsylvania State Highway 997. Chambersburg is the largest town and the county seat, with 17,862 inhabitants. Surrounding population centers with populations greater than 9,000 include Greene Township (12,284), Guilford Township (13,100), Waynesboro (9,614), and Antrim Township (12,504). LEAD is located within three townships: Greene, Letterkenny, and Hamilton.

LEAD was established in 1942 as an ammunition storage facility. In subsequent years the following missions were added:

- Reserve storage and export, advance storage of parts, tools, supplies, and equipment for combat vehicles, artillery, small munitions, and vehicle fire control equipment (1943).
- Receipt and storage of hardware, heavy-duty trucks, and parts (1944).
- Establishment of transport and combat vehicle shops and expansion of the maintenance program (1947).
- Establishment of a rebuild system for guided missile ground control, launching, and handling equipment; missile propellant systems; and internal guidance systems (1954).
- Assignment of the special weapons mission (1958).
- Designation of the Depot as the Eastern Equipment Assembly Area (1959). This mission gave the Depot responsibility for the handling and shipment of equipment for guided missile and special weapons units to overseas locations.
- Acceptance and destruction of U.S. Air Force (USAF) missile fuel (1961).
- Letterkenny Ordnance Depot was renamed the Letterkenny Army Depot (1962).
- Disposal of explosive ordnance from the Army as well as from state and local police (1964).
- Rebuilding artillery recoil mechanisms and maintenance and storage of USAF missiles (1966).
- Receipt, storage, and dispersal of batteries and tires to Army units (1972).
- Operation of a washout facility to reclaim explosives from munitions (1973).

Many of these missions/activities involved the use and/or disposal of chlorinated solvents, primarily trichloroethene (TCE) and 1,1,1-trichloroethane (TCA), along with petroleum hydrocarbons and other solvents.

During the 1970s and 1980s, LEAD undertook several construction and modernization projects. New facilities, including a Care and Preservation Building, chrome plating facility, and radiographic inspection facility, were constructed. Several large modernization projects were completed, including the Automated Storage and Retrieval System-Plus, which provides state-of-the-art support to maintenance operations. During the cold war years, new missions in the maintenance of weapon systems—particularly Hawk, Patriot, and Paladin—were added.

- As a result of the 1995 Base Realignment and Closure (BRAC) Commission's recommendation, LEAD's mission was to be realigned by transferring the towed and self-propelled howitzer mission to Anniston Army Depot and by transitioning missile guidance and control to Tobyhanna Army Depot. As a result of this realignment, property at LEAD will be excessed (turned over to the local community for reuse).

Current or past operations conducted at LEAD involved cleaning, stripping, plating, lubrication, demolition, chemical/petroleum transfer/storage, and washout/deactivation of ammunition. Most of the above operations were accomplished using trichloroethene (TCE), other chlorinated solvents, and petroleum distillates.

In July 1987, the Southeastern Area (SE) of LEAD was listed on the NPL with a Hazard Ranking Score (HRS) of 34.21. On March 1989, the Property Disposal Office (PDO) Area of LEAD was placed on the National Priorities List (NPL); the HRS Score was 37.51. The locations of the SE and PDO Areas at LEAD are shown in Figure 2. Major Tenant activity on Depot includes the Defense Reutilization Marketing Office (DRMO) and the Defense Logistics Agency (DLA).

On 3 February 1989, a Federal Facility Interagency Agreement (IAG), was signed by the U.S. Army, EPA, and Pennsylvania Department of Environmental Resources (PADER) [pertaining to RCRA and Clean Streams Law issues]. The IAG established the framework for the CERCLA response actions at LEAD and required the review of all documents concerning the investigation of environmental contamination at LEAD produced prior to the IAG. PADER has since changed its name to the Pennsylvania Department of Environmental Protection (PADEP).

### 3.1 DESCRIPTION OF THE SOUTHEASTERN AREA OPERABLE UNITS

At the time the K Area Record of Decision (ROD) was signed, the following three Operable Units (OUs) were identified:

- SE OU 1—K-Areas
- SE OU 2—Industrial Wastewater Sewer System
- SE OU 3—Disposal Area VOC-Contaminated Groundwater

Additional OUs were designated based on the results of the Final SE OU 3 Remedial Investigation (RI) Report (ESE 1993). The four additional OUs created within the SE Area included:

- SE OU 4—Stormwater Sewer Lines and Associated Drainageways
- SE OU 5—Area A and B Contaminated Soils
- SE OU 6—SE Area Offpost Contaminated Groundwater
- SE OU 7—Truck Open Storage Area

To support the 1995 Base Closure and Realignment (BRAC) decision to realign the LEAD mission, SE OU 8 was created to deal with all waste sites within the BRAC property boundary.

- SE OU 8—BRAC Waste Sites

In February 1999, two additional OUs were created

- SE OU 9—Landfill J
- SE OU 10—Southern Southeast Industrial Area (SSIA) VOC-Contaminated Groundwater

In 2001, two additional OUs were created:

- SE OU 11—Northern Southeast Industrial Area (NSIA) VOC-Contaminated Groundwater North of Gate 6
- SE OU 12—Landfill G

### **3.1.1 SE OU 1—K-Areas**

The K-Areas were used for the disposal of waste generated from LEAD activities. The locations of the K-Areas are shown in Figure 3. The K-1 area (or K-1 Lagoon) was used to dispose of waste solvents used in painting, paint stripping, and degreasing operations at LEAD. The K-1 Area was in use from 1957 to 1970. Its dimensions were approximately 200 ft by 50 ft. The area of VOC impacted soil was approximately 78 ft by 189 ft.

The K-2 area was in use from 1965 to 1970 and included five partially revetted areas used to accumulate solid waste prior to disposal into a nearby landfill. Its dimensions are approximately 270 ft by 75 ft. It appears that when the K-1 lagoon was closed some soil from K-1 ended up at K-2. The area impacted at K-2 was a 60-ft by 20-ft area approximately 10 ft deep.

The K-3 area was in use as a drum storage area from 1965 to 1970 and covered an overall area of approximately 100 ft by 40 ft. Based on available soil analytical data, the actual contaminated area was limited to a 50-ft by 50-ft area.

An Initial Installation Assessment of LEAD was performed in 1978 and the Discovery Phase was initiated in January 1979. This study concluded that toxic materials associated with the industrial activities at LEAD, along with uncertain past disposal practices, and the nature of the hydrogeologic regime offered significant potential for contamination by chlorinated hydrocarbons and contaminant migration. The Disposal Area (DA) where the K-areas were located was identified as a potential VOC-contamination source.

In 1983, Roy F. Weston, Inc. (WESTON®) completed an investigation of the DA. As part of this effort, trenching and soil boring investigations were conducted at K-1, K-2, and K-3. This investigation revealed the presence of volatile organic compounds (VOCs) including TCE, 1,2-dichloroethene (DCE), and 1,1,2,2-tetrachloroethane in elevated concentrations in the K Areas.

In 1989, WESTON performed a comprehensive soil gas investigation in the DA. The results of the soil gas survey identified that high levels of VOCs existed in the vadose zone soils of the K Areas.

In 1992, Environmental Science and Engineering, Inc. (ESE) conducted a soil boring program to delineate the boundaries of the K Areas. This effort discovered that the K Areas contained higher levels of VOCs than originally thought. Polychlorinated biphenyls (PCBs), metals, and semivolatile organic compounds (SVOCs) were also discovered. The remedial action for the K-Areas was completed in September 1995 and the final documentation was completed in November 1997.

### **3.1.2 SE OU 2—Industrial Wastewater Sewer System**

Problems with the Industrial Wastewater Storm Sewers (IWWS) were first identified in the 1993 RI Report for the Southeastern Area. Studies of the lines showed that numerous breaks and/or leaks existed in both sewer systems. Leak testing and sampling was conducted in the vicinity of the IWWS lines, which showed VOCs had leaked from the IWWS and migrated to bedrock. Emergency repairs were made to the IWWS beginning in October 1994 and completed in December 1995. An engineering evaluation/cost analysis (EE/CA) was prepared by LEAD to address the removal of contaminated soils associated with the leaking IWWS lines. LEAD conducted an emergency removal action of the IWWS-contaminated soils in summer 1997. A Remedial Investigation/Risk Assessment (RI/RA) Draft Report has been reviewed. A draft FS is expected in November 2001.

### **3.1.3 SE OU 3—Disposal Area VOC-Contaminated Groundwater**

SE OU 3 deals with onpost groundwater contamination in the Disposal Area. Figure 4 is a map showing the locations of the groundwater OUs at LEAD. Groundwater in the vicinity of the Disposal Area (DA) is contaminated with chlorinated solvents. Dye studies have shown that water from areas within OU 3 is discharging offpost at 6 separate springs; VOCs have also been detected in these springs. The source of this contamination was the DA. Although the primary sources of contamination have been addressed, VOCs are still being detected; most likely due to the presence of contaminated subsurface soils continuing to act as a secondary source.

The Remedial Investigation, Risk Assessment, and Feasibility Study are scheduled to be completed by March 2002. A Focused Feasibility Study (FFS) is underway for the DA. A recirculation well Pilot Study has been completed. An In-situ H<sub>2</sub>O<sub>2</sub> Pilot Study was completed in April 2000. The FFS Draft Report is expected to be produced in October 2001.

### **3.1.4 SE OU 4—Stormwater Sewer Lines and Associated Drainageways**

SE OU 4 consists of the stormwater sewer system and associated sediments. Prior to installation and connection to the IWTP, untreated industrial wastewaters from the SE Area at LEAD were discharged to the depot stormwater sewer system. An EE/CA was prepared to cover the removal of contaminated sediment from the Southeast drainageway and Rowe Run, and to address the emergency repair of associated sinkholes. Beginning in fall 1996, an emergency removal of the sediments and filling of the sinkholes was performed. These actions were completed in April 1997. A Draft Field Activity Report was prepared in August 2000 and is expected to be finalized in December 2001.

### **3.1.5 SE OU 5—Area A and B Contaminated Soils**

Areas A and B comprise OU 5 in the SE Area (see Figure 3). Areas A and B were initially investigated in the 1980s. Contamination detected in Area A consisted of total petroleum hydrocarbons (TPH) and lead. The most recent rounds of sampling to delineate the extent of contamination were completed in July 1995, when a localized spill area of elevated VOC-concentrations was identified. An EE/CA was prepared and an emergency removal action consisting of excavation and disposal of VOC-contaminated soil in the spill area was conducted in summer 1997.

Area B was a former Oil Burn Pit (OBP). The soil in this area was found to contain TPH and lead; the groundwater was found to contain VOCs (not from Area B). Area B will be further evaluated as part of the CERCLA RI process.

SE OU 5 is currently undergoing a Remedial Investigation, Risk Assessment, and Feasibility Study. A Draft RI/RA Report was completed in July 2000. The RI/RA/FS is scheduled for completion March 2003.

### **3.1.6 SE OU 6—SE Area Offpost Contaminated Groundwater**

SE OU 6 includes the discharge points of 6 VOC-impacted off-post springs and off-post VOC-contaminated groundwater associated with SE OU 3 and SE OU 11, including residential drinking water wells. A final dye study, initiated in September 1995, included the placement of dye in monitor wells located near LEAD's property line and in Rowe Run (boundary trace). This study was completed in December 1995.

In addition to the springs, off-post wells were also evaluated as part of SE OU 6. Approximately 50 wells were sampled and results were analyzed for VOC and metals concentrations during the past 2 years. The results from this sampling indicated no additional VOC-contaminated off-post wells other than those previously identified.

A third study area of the off-post groundwater impacts was an evaluation of farm animals and farm animal products located on farms near the SE Area. Samples of eggs, milk, and meat were collected from numerous farms. Results from this sampling did not indicate the presence of

VOCs or metals in the various media at concentrations above literature values or regional background levels.

An RI/RA Draft Report is expected to be submitted in 3 November 2001.

### **3.1.7 SE OU 7—Truck Open Storage Area**

Sampling of SE OU 7 was initially conducted in summer 1994. This area consisted of an open storage area for trucks and an abandoned septic tank used as an oil/water separator (see Figure 3). Analytical results from this sampling have shown no significant soil contamination present at SE OU 7. The detected groundwater contamination is attributable to SIA sources, and not SE OU 7. During the investigation of SE OU 7, an abandoned septic system was found. The septic tank was used as an oil/water separator for disposal of sanitary sewage from LEAD holding tanks. A removal action was conducted in spring 1997, which consisted of characterization, solidification and removal of the tank contents, backfilling of the tank, and restoration of the site.

A supplemental investigation was conducted in 1999 for the presence of polychlorinated dibenzo-p-dioxins and dibenzofurans (dioxins/furans), and polychlorinated biphenyls (PCBs). The results of the investigation were published in July 2000 and showed that the presence of dioxins/furans in burned material was at concentrations greater than the published (EPA Region III) industrial direct contact human health level. A time-critical removal action was completed in this area in December 2000.

### **3.1.8 SE OU 8—BRAC Waste Sites**

The SE OU 8 area is composed of potential sites identified in the to-be-excessed portion of the SE Area. SE OU 8 is being investigated under the BRAC investigation program. The locations of the SE OU 8 sites are shown in Figure 5.

Findings of Suitability to Lease (FOSLs) have been signed for the following SE areas: Buildings 6, 9, 19, 412, 416, 500, 522, 2291, 7, 8, and 42. A FOSL was also signed that covered the remainder of the BRAC buildings in the SE area (Phase II FOSL, February 2000). The Phase One BRAC Transfer was completed in 1998. A ROD for the Phase One areas was signed in September 1998. A Finding of Suitability to Transfer (FOST) was signed in October 1998. The following areas comprise the SE portions of Phase One: Parcels 1 through 13, Parcels 16 through 27, and Parcel 31. Phase II Transfer is scheduled to be completed by October 2001. A ROD for the Phase II areas was signed in July 2001. Parcels 2-35 through 2-77 (with the exception of Parcel 2-73) comprise the SE portions of Phase Two. A FOST is expected to be signed in October 2001.

### **3.1.9 SE OU 9—Landfill J**

SE OU 9 consists of a landfill (Landfill J) located west of Building 320. The location of Landfill J was discovered in 1995 while trenching for utilities (see Figure 3). The extent of the landfill was determined using geophysical techniques and trenching. The characteristics of the soils and

groundwater were evaluated through several sampling efforts. An emergency removal action was conducted in June 2001. A draft Removal Action Completion Report, which will include RI/RA data, is expected to be produced August 2002.

#### **3.1.10 SE OU 10—SSIA VOC-Contaminated Groundwater**

SE OU 10 consists of contaminated groundwater south of Gate 6. SE OU 10 was created when SE OU 3 was divided at the groundwater/surface water divide near Gate 6 (see Figure 4). The sources of the groundwater contamination for SE OU 10 are the formerly leaking IWWS lines in the vicinity of Building 37 (VOC-contaminants) and a release of a diesel fuel tank in the vicinity of Building 37. Extensive work has been completed in the Building 37 area to design technically sound and cost-effective techniques to mitigate the contaminated on-site groundwater. An FFS, which includes a pilot study evaluating enhanced bioremediation techniques as a possible way to treat the groundwater, is underway at Building 37. The FFS Draft Report was issued in November 2000.

#### **3.1.11 SE OU 11—NSIA VOC-Contaminated Groundwater North of Gate 6**

SE OU 11 consists of the VOC-contaminated groundwater associated with the IWTP lagoons and industrial sewers. A pilot study was initiated in September 2001 to evaluate the feasibility of treating DNAPL sources and reducing off-site contaminant migration concentrations at the property line. This study is expected to be completed by Spring 2002.

#### **3.1.12 SE OU 12—Landfill G**

The LEAD IA identified this area active from 1964 through 1978, when it was leveled to match the existing terrain. The area was used to dispose of residue from trash burning pits and Industrial Wastewater Treatment Plant (IWTP) sludge. Visibly contaminated leachate (metals) was reported to (and continues to) emanate from this site into a nearby stream. Aerial photographs from 1965 do not reveal landfilling activities at this site, however, aerial photographs from 1970 confirm disposal activities here. A former LEAD worker had identified this area as containing buried drums. A 1991 SI has identified several magnetic anomalies. In 1993 these anomalies were cross trenched. Most anomalies were related to buried metallic objects. This area contained empty buried drums that formerly contained caustics. Sampling indicated that these buried drums had caused no environmental problems. Another anomaly showed a large number of solvent containers. These were drummed and disposed of in this area. The 1995 SI follow-on identified this site as requiring an RI. An RI is underway. This site consists of contaminated soil, groundwater and surface water.

## 3.2 PHYSICAL CHARACTERISTICS

### 3.2.1 Climatology

The climate at LEAD is moderate, with an average annual temperature of 11.2° C (52° F). Summers average 22.3° C (72° F) and winters average 0° C (32° F). Rainfall averages 98.2 centimeters (cm) (38.7 inches). The moderate climate results in an average of 15 days above 32° C (90° F) per year and mild winters with temperatures below 0° C (32° F) occurring less than 100 days per year. Winds are generally from the southwest, with an average velocity of 10 miles per hour (mph). During the period from July to mid-September, the area experiences warm periods lasting 4 to 5 days, during which time there is high relative humidity and only slight wind movement. Typically, below-freezing temperatures occur for less than 100 days per year during the winter (EA, 1991).

### 3.2.2 Site Topography and Surface Drainage

LEAD is located in the Great Valley section of the Valley Ridge Province of the eastern United States, and referred to locally as the Cumberland Valley. The Cumberland Valley trends northeast to southwest through central Pennsylvania and is bordered to the west by the Appalachian Mountain Province. The South Mountain section of the Blue Ridge Province is situated east of Chambersburg and marks the eastern edge of the Cumberland Valley.

The Cumberland Valley is characterized by southwest-trending limestone ridges and valleys. The valley floors are filled with rocks of the Martinsburg Formation. Weathering of the folded and faulted underlying geologic formations imparts a gently rolling aspect to the local topography. The majority of LEAD is located within the Martinsburg Shale terrain, except for bands of carbonate rocks along the eastern and western edges of LEAD. The PDO Area and the SIA of LEAD are underlain by limestone. Surface elevations throughout LEAD range from approximately 600 to 750 ft above mean sea level (msl), except for the northwest portion of LEAD, where the elevation increases abruptly to more than 2,300 ft above msl in the vicinity of Broad Mountain (EA, 1991).

Streams cutting through the limestone terrain flow through broad, open valleys and are usually intermittent. In contrast to this, streams cutting through the upper shale units of the Martinsburg Formation usually meander in small, steep-walled valleys and are perennial. Surface drainage at LEAD is divided into two watersheds, the Susquehanna River to the northeast and the Potomac River to the southwest. Both the Susquehanna and Potomac Rivers eventually drain into the Chesapeake Bay.

Two major stormwater drain systems serve the southeast portion of LEAD and contribute to local surface drainage. One system serves the area north of Coffey Avenue and discharges near the IWTP into the industrial wastewater plant outfall (located north of the IWTP), which discharges to Rowe Run. The other system serves the southeast warehouse area. Water drains into the storm drain system, is discharged through the storm drain outfall, and joins other surface

runoff flowing southward to Conococheague Creek (USATHAMA, 1980). Figure 6 illustrates the drainage system and drainage divides at LEAD.

### 3.2.3 Soils

Surface soils present at LEAD are predominantly shaley to very shaley silt loams that developed through weathering of the Martinsburg Shale and the interbedded siltstones and sandstones. According to the Soils Survey Bulletin of Franklin County, these soils have been classified as part of the Weikert-Berks-Bedington Association (see Figure 7). Soils on the eastern edge of LEAD associated with the limestone have been identified as part of the Hagerstown-Duffield Association. These soils are deep, level or sloping, somewhat poorly drained, and mostly rocky, silty, clay loams. Along the western side of LEAD, outside of the BRAC area, are soils of both the Laidig-very stony Land-Buchanan Association (formed from sandstone) and the Morrill-Laidig Association (formed on the foot of mountain slopes) (USATHAMA, 1980).

### 3.2.4 Geology

LEAD straddles two major structural features; the South Mountain anticlinorium to the east and the Massanutten synclinorium to the west. The eastern portion of the Depot (underlain by carbonate rocks) is part of the anticlinorium, whereas the western portion of the Depot (underlain by shale) is part of the synclinorium. These structures resulted from folding that occurred during the close of the Paleozoic era. High-angle reverse faulting accompanied the folding of rocks in the eastern portion of LEAD. Several major faults, which strike north to northeast and dip to the southeast at fairly steep angles, cross the PDO Area (WESTON, 1984).

In the vicinity of LEAD, the Great Valley is floored by Ordovician age carbonate rock, as well as Ordovician age shale and greywacke of the Martinsburg Formation. The five formations occurring at LEAD are the shales of the Martinsburg Formation, the limestones of the Chambersburg Formation and the St. Paul Group, the limestones and dolomites of the Rockdale Run Formation, and the dolomites of the Pinesburg Station Formation. These geologic formations are fractured and deformed to varying degrees from past geologic activity (ESE, 1993). Figure 8 shows the geologic units of the eastern part of LEAD.

Several faults extend through LEAD, including the Pinola and Letterkenny Faults. Although an east-to-west cross fault was identified between these two faults, both the position and surface trace are open to question (Becher and Taylor, 1982). Northeast of LEAD, the Pinola Fault truncates the Letterkenny Fault, indicating that the latter fault is older.

The Letterkenny Fault is one of the few faults in the region that parallels the tectonic grain, yet is an early formed, westward-dipping thrust that moved material from within the syncline to the west up onto the anticline to the east (EA, 1991).

The Pinola Fault, located to the west of the Letterkenny Fault, is considered to be an east-dipping, high-angle thrust fault (based on the fact that older beds are to the east of the fault). Because it is almost impossible to trace faults through the Martinsburg terrain, the fault trace is

projected through the Martinsburg Formation on the basis of a ridge-forming unit that extends through it (Becher and Taylor, 1982).

### 3.2.5 Hydrogeology

The regional surface water flow system of Franklin County controls the general groundwater flow patterns within LEAD. The surface water drainage divide, discussed previously, also divides the groundwater flow system into two basins. Groundwater elevation contours within LEAD generally reflect surface topography. The water table is located at moderate depth in areas of topographic highs and is shallow near stream valleys and other topographic lows (ERM, 1995).

The shale and carbonate rock that underlie LEAD have been disturbed and faulted during deformational events that ultimately formed the Great Valley. The two major faults located within the confines of LEAD (the Pinola Fault and the Letterkenny Fault) influence groundwater flow. Where faulting is present and dissimilar rocks have been brought into contact, the fault tends to act as a barrier to groundwater movement, occasionally forcing water within the formation to discharge as a fault spring (i.e., Rocky Spring). Where similar rocks are in contact along a fault (i.e., two limestone units), the groundwater movement may be only minimally affected (ERM, 1995).

Fracture systems within the Martinsburg Formation are small and well connected, thus allowing groundwater to generally follow a regional flow path. Groundwater flow within the limestone of the Chambersburg Formation and St. Paul Group is more complex because it occurs predominantly through individual fractures and solution cavities typical of karst terrain. Fractures in the limestones are mostly aligned with the regional northeast tectonic grain and are much more irregular and widely spaced than those in the adjacent shales. Where solution cavities are present in the limestone, groundwater flow more closely resembles open channel flow rather than the fracture flow described above. The quantity and density of fractures within the limestone units increase with proximity to the bedrock surface. During seasonal periods when the water table is at its highest (early spring, late autumn), water levels commonly rise above the bedrock/surface material contact. Leaching or resuspension of any materials or potential contaminants buried in the surficial sediments may be enhanced during high water table conditions. Table 2 presents a description of the water-bearing characteristics of the geologic units present at LEAD (ERM, 1995).

Groundwater recharge occurs primarily through precipitation. Recharge areas occur throughout the central part of LEAD, wherever sandstone, siltstone, or joints are close to the surface. Actual points of recharge for the limestone aquifers have not been determined; however, the many faults, joints, and sinkholes present at LEAD are the most likely routes (ERM, 1995).

Groundwater underlying LEAD generally occurs under unconfined conditions, with local areas of artesian conditions. These artesian conditions occur along a moderately steep slope located near the northwest edge of LEAD in the Ammo Area.

A groundwater study completed for the USACE Baltimore District in the 1950s concluded that there was not a viable source of groundwater available within LEAD boundaries to supply the

Table 2

## Description and Water Bearing Characteristics of the Geologic Units at Letterkenny Army Depot

System	Geologic Unit	Thickness (ft)	Character of Rocks	Water-Bearing Characteristics
Quaternary	Colluvium	0-250	Mixture of clay, silt, sand, pebbles, cobbles, and boulders overlying a thick residual clay layer.	Yields domestic supplies commonly at the contact with bedrock. Provides extra storage for underlying limestone. Maximum reported yield is 30 gpm from sand and gravel. Calculated maximum sustained yield is 110 gpm.
Ordovician	Martinsburg Formation	1,500-3,000	Thin basal unit of platy limestone; thick medial unit of graywacke; bulk of formation is black carbonaceous and fissile shale. Formation is thinner to west.	Good aquifer. Maximum reported yields are 150 gpm from shale and 50 gpm from graywacke. Calculated maximum sustained yield is 100 gpm for shale and graywacke. No data are available for basal limestone. Only 3% of wells need standby storage to supply minimum domestic needs.
	Chambersburg Formation	300-750	Dark-gray, thin-bedded limestone that characteristically weathers into cobblestone shapes. Thinner to west. Abundantly fossiliferous.	Fair Aquifer. Maximum reported yield is 225 gpm. Calculated maximum sustained yield is 160 gpm. Approximately 30% of wells require standby storage to supply minimum domestic needs.
	St. Paul Group	800-1,000	Light-gray limestone; minor interbeds of dolomite containing black chert. Thinner to west. Abundantly fossiliferous.	Fair aquifer. Maximum reported yield is 225 gpm. Calculated maximum sustained yield is 160 gpm. Approximately 30% of wells require standby storage to supply minimum domestic needs.
	Pinesburg Station Formation	250-800	Medium-gray dolomite; some interbeds of limestone. Black chert and white quartz.	Fair aquifer. Maximum reported yield is 30 gpm. Calculated maximum sustained yield is 150 gpm. About 25% of wells require standby storage for minimum domestic supply.

Source: Becher, A.E. and L.E. Taylor. 1982. *Groundwater Resources in the Cumberland and Contiguous Valleys of Franklin County, Pennsylvania*. Pennsylvania Geological Survey Water Resources Report 53. Harrisburg, PA.

depot's industrial mission (Acker, 1955). The only use of groundwater in the area is outside LEAD, where some individual homes depend on groundwater for their domestic supply. Any homes on well water that were determined to be impacted by the groundwater contamination at LEAD (exceed maximum contaminant levels [MCLs] for VOCs) were initially supplied with bottled water, but are now connected to public water. Off-post VOC-contaminated groundwater is used to water livestock and produce.

### 3.3 CONTAMINATION ASSESSMENT

#### 3.3.1 SE OU 1—K-Areas

The K-Areas are located in the Disposal Area (DA) of LEAD and consist of Areas K-1, K-2, and K-3. The K-1 lagoon was used to dispose of waste industrial solvents. The K-1 lagoon was closed in the 1970s. The Remedial Action (removal of VOC-contaminated soil) was completed at the site in 1995. Contaminants in the soils in this area were at concentrations of up to 5.5% total VOCs. The most common VOCs were:

- trans-1,2-Dichloroethene
- Methylene chloride
- 1,1,1-Trichloroethane
- Trichloroethene

The groundwater in the SE Area is contaminated with the same VOCs as the soils from the K Area, with concentrations in the groundwater occurring at up to 20,000 micrograms per liter (µg/L). Disposal Area VOC groundwater contamination is being addressed by SE OU 3. Lead was present at concentrations of up to 1.5% in the soils. TAL metals contamination of the groundwater is not an issue. Response is complete at this site.

#### 3.3.2 SE OU 2—Industrial Wastewater Sewer System

The Industrial Waste Water Sewer (IWWS) System malfunctioned soon after it was installed in the mid 1950s. This allowed VOC-contaminated wastewater to infiltrate directly into the soils and bedrock, causing groundwater contamination. RI Field Work in 1992 and 1993 led to emergency repairs in 1994 and 1995. An emergency removal of IWWS VOC-contaminated soils was conducted in 1997.

Soils surrounding the IWWS were contaminated with VOCs contributing to Onpost and Offpost VOC groundwater contamination. Although the emergency repairs to the IWWS eliminated the primary source of chemical release, the affected underlying soils were a source of chemical release to receiving media such as groundwater, surface water/sediment, and ambient air.

The following chemicals were identified as COPCs:

- 1,1-Dichloroethene
- 1,2-Dichloroethene, total

- Methylene chloride
- Tetrachloroethene
- Trichloroethene
- 1,1,1-Trichloroethane

**SE OU 2—IWWS Sewers  
Chemicals of Potential Concern in Soil**

Chemical	Max. Conc. (mg/kg)
<u>VOCs</u>	
Trichloroethene	1,700
<u>SVOCs</u>	
Benzo (a) pyrene	0.5
<u>Metals</u>	
Antimony	3.5
Barium	1,050
Beryllium	4.6
Chromium	226
Lead	2,090
Nickel	83
Thallium	18

### 3.3.3 SE OU 3—Disposal Area VOC-Contaminated Groundwater

The SE OU 3 DA VOC-Contaminated Groundwater is located north of NSIA. SE OU 3 consists of the DA.

In the DA Area the groundwater is contaminated with up to 20,000 ppb of total VOCs. The source of this VOC groundwater contamination is Area K-1 (see SE OU 1 above) and the former Spill Area in Area A (see SE OU 5 below). Both of these areas have been remediated. This onpost VOC-contaminated groundwater migrates offpost (see SE OU 6).

The most common VOCs in the DA are:

- 1,2-Dichloroethene
- Trichloroethene
- Tetrachloroethene
- Vinyl chloride

### 3.3.4 SE OU 4—Stormwater Sewer Lines and Associated Drainageways

SE OU 4 consists of the stormwater sewer system and associated downstream sediments in the Rowe and Southeast drainageways. Based on the results of the RI investigation, the following COCs were identified:

The COCs are:

- SVOCs
- PCBs
- Lead

An Emergency Removal of drainageway sediments was completed in 1997. The post-removal results are summarized below.

**SE OU 4—Drainageway Sediments  
Chemicals of Potential Concern in Sediment  
(Post-Removal)**

Chemical	Max. Conc. (mg/kg)
VOCs None	—
SVOCs Phenanthrene	0.15
Metals Arsenic	7.5
Iron	5,720
Mercury	0.27

### 3.3.5 SE OU 5—Areas A and B Contaminated Soils

SE OU 5 consists of three areas:

**Area A:** Waste Disposal Trench Area. Area A is approximately 5 acres in size And was used to dispose of sand blasting abrasive and organic liquid/sludge.

The COCs were:

- SVOCs
- Lead

**Spill Area in Area A:** Formerly thought to be the site of a spill/release of TCE. It was discovered during a 1997 emergency removal that the site contained laboratory containers of VOCs.

The COCs were:

- LEAD
- Trichloroethene

**Area B:** Clay-Lined Oil Burn Pit (OBP), used to burn waste oil. An RI has determined that the OBP is not a source of VOCs to the groundwater.

The COCs are:

- SVOCs
- Lead

The COCs are summarized below.

**SE OU 5—Areas A and B  
Chemicals of Potential Concern in Soil**

Chemical	Max. Conc. (mg/kg)
<u>VOCs</u>	
1,2-Dichloroethene	3
Benzene	0.4
Chlorobenzene	50
Methylene Chloride	0.08
Trichlorethene	0.2
Vinyl Chloride	0.2
<u>SVOCs</u>	
4-Methylphenol	10
Naphthalene	90
<u>Metals</u>	
Antimony	160
Cadmium	80
Copper	190,000
Lead	4,590
Thallium	52

### 3.3.6 SE OU 6—SE Area Offpost Contaminated Groundwater

SE OU 6 includes Offpost VOC-contaminated groundwater at LEAD associated with SE OU 3 and SE OU 11. To the north of Gate 6 is the Rowe Run Drainage Area. The Onpost sources for this area of groundwater contamination are the IWWS, IWTP Lagoons, and the DA (Area K-1). Six VOC-contaminated springs exceeded ARARs. Residential groundwater exceedances up to 2 miles Offpost (all homes with a groundwater ARARs exceedance have been placed on a public water supply). A summary of the COCs is summarized below.

**SE OU 6—SE Area Offpost (Wells) Groundwater  
Chemicals of Potential Concern in Groundwater (1994-1996)**

<b>Chemical</b>	<b>Max. Conc. (µg/L)</b>
<u>VOCs</u>	
1,1-Dichloroethene	2.4
1,1,1-Trichloroethane	44
Trichloroethene	7.3
1,2-Dichloroethene	15
Chloroform	200
Chloromethane	10
<u>SVOCs</u>	
None	—
<u>Metals</u>	
Iron	4,090
Manganese	1,530
Lead	18
Zinc	3,700

### 3.3.7 SE OU 7—Truck Open Storage Area

A former open storage area, with an abandoned septic tank and leaching field, was used to dispose of “boiler slops” and septage. The initial COCs identified were SVOCs and PCBs in the sludge in the septic tank. A removal action for the septic tank was completed in spring 1997. In 1999, polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (dioxins/furans) were discovered at low concentrations at the site in a limited area of shallow (0-1 foot) soils. A time-critical removal action for the dioxin-contaminated soils was performed in December 2000. The COCs for the site are summarized below.

**SE OU 7—Truck Open Storage Area  
Chemicals of Potential Concern in Soil**

<b>Chemical</b>	<b>Max. Conc. (mg/kg)</b>
<u>VOCs</u>	
None	—
<u>SVOCs</u>	
None	—
<u>Metals</u>	
None	—
<u>Dioxins/Furans</u>	156 ng/kg (nanograms per kilogram)

### 3.3.8 SE OU 8—BRAC Waste Sites

The SE OU 8 area is composed of the OVSA, Lot 48 and Gate 1 Guardhouse and potential sites identified in the to-be-excessed (BRAC) portion of the SE Area. This OU is still being investigated. The PCOCs for these sites include:

- VOCs
- SVOCs
- TAL Metals
- Dioxins

### 3.3.9 SE OU 9—Landfill J

Landfill J is an abandoned landfill has been investigated behind Building 320. Additional investigation occurred in 2000 and an emergency removal action was conducted in June 2001. The PCOCs include:

#### SE OU 9—Area J Chemicals of Potential Concern in Soil

Chemical	Max. Conc. (mg/kg)
<u>VOCs</u>	
1,2-Dichloroethene	180
Trichloroethene	6,100
Tetrachloroethene	440
Vinyl Chloride	3
<u>SVOCs</u>	
Naphthalene	105
1,2-Dichlorobenzene	180
1,4-Dichlorobenzene	46
n-Nitrosodiphenylamine	3
Pentachlorophenol	22
Benzo (a) pyrene	287
Benzo (b) fluoranthene	238
Chrysene	283
Pyrene	556
<u>Metals</u>	
Lead	199,000
Cobalt	2370
Antimony	1,370
Cadmium	77
Mercury	17
Thallium	16
Zinc	44,500

**3.3.10 SE OU 10—SSIA VOC-Contaminated Groundwater**

The source of the VOCs is the Building 37 IWWS. RI field work in 1992 and 1993 led to emergency repairs in 1994 and 1995. The site is currently in the FFS stage. The COCs include VOCs (TCE, TCA, and associated breakdown products) and SVOCs related to a diesel fuel release at Building 37. An enhanced biodegradation pilot study is underway and will conclude in 2003.

**3.3.11 SE OU 11—NSIA VOC-Contaminated Groundwater North of Gate 6**

The original unlined lagoon was constructed in 1954 and operated until 1967. The lagoon was used as a settling/equalization basin for the IWTP. Over time, this process led to the generation of a sludge layer in the lagoon. Losses of sludge and untreated wastes from the unlined lagoon had been occurring for an unspecified time. In 1967 a concrete-lined, two-cell lagoon was built over the existing bare earth lagoon. In 1992 the soil in the Lagoon Area was excavated and treated. The groundwater below the lagoon area is contaminated with VOCs. This Onpost VOC-contaminated groundwater migrates offpost (see SE OU 6).

The most common VOCs in the Lagoon Area are:

- Chloroform
- 1,2-Dichloroethane
- 1,1-Dichloroethene
- *cis*-, *trans*-, and total 1,2-Dichloroethene
- Methylene Chloride
- Trichloroethene
- Vinyl chloride

**SE OU 11—NSIA VOC-Contaminated Groundwater North of Gate 6**  
**Chemicals of Potential Concern in Groundwater**

Chemical	Max. Conc. (µg/L)
<u>VOCs</u>	
Chloroform	15
1,2-Dichloroethane	1.8
1,1-Dichloroethene	20
1,2-Dichloroethene ( <i>cis</i> -, <i>trans</i> -, total)	9,900
Methylene Chloride	3.3
Trichloroethene	12,000
Vinyl Chloride	2,200
<u>SVOCs</u>	
None	—
<u>Metals</u>	
None	—

**3.3.12 SE OU 12—Landfill G**

The LEAD IA identified this area active from 1964 through 1978, when it was leveled to match the existing terrain. The area was used to dispose of residue from trash burning pits and Industrial Wastewater Treatment Plant (IWTP) sludge. Visibly contaminated leachate (metals) was reported to (and continues to) emanate from this site into a nearby stream. Aerial photographs from 1965 do not reveal landfilling activities at this site, however, aerial photographs from 1970 confirm disposal activities here. A former LEAD worker had identified this area as containing buried drums. A 1991 SI has identified several magnetic anomalies. In 1993 these anomalies were cross-trenched. Most anomalies were related to buried metallic objects. This area contained empty buried drums that formerly contained caustics. Sampling indicated that these buried drums had caused no environmental problems. Another anomaly showed a large number of solvent containers. These were drummed and disposed of in this area. The 1995 SI follow-on identified this site as requiring an RI. An RI is underway. This site consists of contaminated soil, groundwater and surface water. The CPOCs for this site are summarized in the following tables:

**SE OU 12—Landfill G**  
**Chemicals of Potential Concern in Soil and Sediment**

Chemical	Max. Conc. (mg/kg)
<u>VOCs</u> none	—
<u>SVOCs</u> Benzo(a)pyrene	1.7
<u>Metals</u> none	—

**SE OU 12—Landfill G**  
**Chemicals of Potential Concern in Surface Water**

Chemical	Max. Conc. (µg/L)
<u>VOCs</u> Carbon Disulfide	500
<u>SVOCs</u> None	—
<u>Metals</u> Aluminum Iron Manganese Lead Zinc	5,080 11,900 679 2.6 72.5

**SE OU 12—Landfill G**  
**Chemicals of Potential Concern in Groundwater**

Chemical	Max. Conc. (µg/L)
<u>VOCs</u> Carbon Disulfide	24
<u>SVOCs</u> None	—
<u>Metals</u> Iron Manganese Nickel	114,000 2,670 206

## 4. REMEDIAL ACTIONS

### 4.1 SE OU 1—K-AREAS

#### 4.1.1 Remedy Selection

The ROD for the Southeastern Area OU 1: K Areas was signed on 2 August 1991. The remedial action objective is:

- Minimize the deterioration of groundwater by providing source control of the contaminated soils.

The remedial actions at SE OU 1 are:

- Excavation of 8,000 cubic yards of contaminated soils in the K Area.
- Thermal treatment of contaminated soils at a temperature not greater than 450 °F.
- Destruction of volatilized contaminants by a secondary high-temperature combustor or adsorption of volatilized contaminants onto activated carbon.
- Analysis of representative samples of treated soils and comparison with treatment criteria.
- Return of treated soils to original excavation.

An Explanation of Significant Differences (ESD) for the Southeastern Area OU 1: K Areas was signed on 2 August 1991 as a result of comments provided by EPA to the Army following signature of the ROD by the Army. The ESD clarifies that the appropriate ARARs for any metals found in soils during the remediation at the SE Area are the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. § 6901 *et seq.*, Land Disposal Restrictions promulgated at 40 C.F.R. Part 268, and that the Pennsylvania proposed regulations on residual waste management are “To Be Considered” (TBC) in implementing the proposed remedy.

#### 4.1.2 Remedy Implementation

The remedial design for the site was started in September 1991 and completed in June 1993. The plans called for the Army to excavate all soils in the K-Areas that contained 225 parts per billion (ppb) of trichloroethene or greater. The soils were to be treated using Low Temperature Thermal Treatment (LT<sup>3</sup>). Excavation to bedrock (the limits of mechanical excavation) yielded approximately 14,100 yd<sup>3</sup> of soil from Areas K-1, K-2, and K-3 to be treated. Mobilization began in August 1993.

#### 4.1.2.1 *LT<sup>3</sup> Treatment*

The LT<sup>3</sup> system was required to remove TCE from the impacted soils down to a residual concentration level of 50 ppb as well as remove other target organic contaminants to the residual Land Disposal Restriction (LDR) concentration limits specified in 40 CFR 268.41. In addition, the LT<sup>3</sup> system was required to comply with all applicable air emissions standards to include a particulate matter concentration of less than 0.08 grains per dry standard cubic foot (dscf) and a 99% removal efficiency of target organic compounds. LT<sup>3</sup> technology was previously used to successfully treat impacted soil at LEAD's Industrial Wastewater Treatment Plant (IWTP) lagoons.

The following performance requirements were required:

▪ Trichloroethene	50 ppb
▪ Acetone	160,000 ppb
▪ Benzene	3,700 ppb
▪ Carbon Tetrachloride	5,600 ppb
▪ Chlorobenzene	5,700 ppb
▪ O-Dichlorobenzene	6,200 ppb
▪ 1,1,1-Trichloroethane	5,600 ppb
▪ 1,1,2-Trichloroethane	7,600 ppb
▪ Trichloroethylene	5,600 ppb
▪ Tetrachloroethene	5,600 ppb
▪ Ethyl Benzene	6,000 ppb
▪ Toluene	28,000 ppb
▪ Xylene (Total)	28,000 ppb

#### 4.1.2.2 *Stabilization*

Following LT<sup>3</sup>, approximately 4,000 yd<sup>3</sup> of soil that exceeded TCLP standards for lead were treated (fixated) to meet the TCLP regulatory requirements of 5 ppm.

#### 4.1.2.3 *Backfilling*

LT<sup>3</sup> treated and stabilized soil was returned to the area it was excavated from. These soils were placed into all of the excavations in 8-inch lifts and compacted. The K Areas were returned to their pre-remediation contours or, where necessary, modified to promote surface water drainage and prevent ponding or collection of surface water. Slopes associated with final grading were constructed and maintained to ensure permanent stability, control erosion, and to allow for the placement of the cover.

#### **4.1.2.4 Construction of Class III Residual Waste Landfill**

The cover system placed on the K Areas was required to meet all final cover requirements of the PADER Title 25 Residual Waste Management Regulations, Chapter 288, pertaining to class III residual waste landfills.

A minimum of 12 inches of the intermediate cover layer was installed in no greater than 8-inch lifts. A 40-mil geomembrane was installed onto the completed intermediate layer. The drainage layer consisted of a Geotextile over a Geonet layer. Cover soil was placed on the drainage layer in a manner that prevented damage to and wrinkling of the Geotextile and Geonet. Topsoil was installed over the cover soil. The topsoil layer was then seeded and mulched.

#### **4.1.2.5 Project Schedule**

August 1993 -	Began Mobilization and Excavation Shoring activities
September 1993 -	Completed Mobilization activities
November 1993 -	Received PADER Exemption Approval for LT <sup>3</sup> system
November 1993 -	Continued Excavation/Treatment/Backfill activities
January 1994 -	Suspension of Work pending regulatory approval of the Solidification/Stabilization Treatability report
April 1994 -	Resumed Excavation/Treatment/Backfill activities
October 1994 -	Completed Excavation/Treatment/Backfill activities
November 1994 -	Began Final Cap/Site Restoration activities
September 1995 -	Completed Capping and Site Demobilization activities

#### **4.1.2.6 Cost**

The total cost of the Remedial Action was \$4,295,578.

The contract cost of the Remedial Action was \$3,905,256.

Excavation costs were \$24.77 per yd<sup>3</sup>.

LT<sup>3</sup> treatment costs were \$74.70 per yd<sup>3</sup>.

TCLP soils stabilization costs were \$17.13 per yd<sup>3</sup>.

### **4.1.3 Operation and Maintenance**

The operation and maintenance plan and schedule for the capped areas in the K Area is documented in the SE OU 1 (K-Areas) *Vegetative* cover Preventative Maintenance and Corrective Action Standard Operating Procedure (USACE, 2000).

### **4.1.4 Current Status**

The Army has conducted visual inspections of the capped areas yearly. An inspection conducted on 1 August 2001 (and subsequent video inspection of small animal burrows on 28 September 2001) indicated that the vegetative cover, the under drainage system, and the liner are intact. The U.S. Navy installed two test-monitoring wells in December 1997 as part of a Three-Dimensional Seismic Technology Demonstration effort. Such wells were installed on the toe of the cap and did not penetrate the liner.

In spring 1999 the Army installed four in situ hydrogen peroxide injectors to support a pilot study. These injectors did penetrate the liner. Polyethylene boots were attached to the liner and clamped to the injector casing, maintaining liner integrity. This effort supports the SE OU 3 FFS that addresses the VOC groundwater contamination caused by the K Areas.

## **4.2 SE OU 2—INDUSTRIAL WASTEWATER SEWER SYSTEM**

### **4.2.1 Remedy Selection**

As of August 2001, no remedial action has been selected.

### **4.2.2 Remedy Implementation**

Not applicable.

### **4.2.3 Operation and Maintenance**

Not applicable.

## **4.3 SE OU 3—DISPOSAL AREA VOC-CONTAMINATED GROUNDWATER**

### **4.3.1 Remedy Selection**

As of August 2001, no remedial action has been selected.

#### **4.3.2      Remedy Implementation**

Not applicable.

#### **4.3.3      Operation and Maintenance**

Not applicable.

### **4.4      SE OU 4—STORMWATER SEWER LINES AND ASSOCIATED DRAINAGEWAYS**

#### **4.4.1      Remedy Selection**

As of August 2001, no remedial action has been selected.

#### **4.4.2      Remedy Implementation**

Not applicable.

#### **4.4.3      Operation and Maintenance**

Not applicable.

### **4.5      SE OU 5—AREA A AND B CONTAMINATED SOILS**

#### **4.5.1      Remedy Selection**

As of August 2001, no remedial action has been selected.

#### **4.5.2      Remedy Implementation**

Not applicable.

#### **4.5.3      Operation and Maintenance**

Not applicable.

## **4.6 SE OU 6—SE AREA OFFPOST CONTAMINATED GROUNDWATER**

### **4.6.1 Remedy Selection**

As of August 2001, no remedial action has been selected.

### **4.6.2 Remedy Implementation**

Not applicable.

### **4.6.3 Operation and Maintenance**

Not applicable.

## **4.7 SE OU 7—TRUCK OPEN STORAGE AREA**

### **4.7.1 Remedy Selection**

As of August 2001, no remedial action has been selected.

### **4.7.2 Remedy Implementation**

Not applicable.

### **4.7.3 Operation and Maintenance**

Not applicable.

## **4.8 SE OU 8—BRAC WASTE SITES**

### **4.8.1 Remedy Selection**

A Proposed Plan (PP) (WESTON, 1998a) was approved and a ROD (WESTON, 1998b) was signed in September 1998 for the Phase I Parcels. The ROD specified institutional controls as the final remedy for soils and the interim remedy for groundwater. The following areas comprise the SE portions of Phase One: Parcels 1 and 2, Parcels 3 and 4, Parcel 5, Parcel 6, Parcel 7, Parcel 8, Parcel 9, Parcels 10 through 13, Parcels 16 through 21, Parcels 22 and 31, Parcel 23, Parcel 24, Parcel 25, Parcel 26, and Parcel 27. The locations of these parcels in the SE Area are shown in Figure 9.

The following documents were completed and approved to support the ROD for the Phase I Parcels in the SE Area.

- *Decision Document for BRAC Parcels 1 and 2, Letterkenny Army Depot* (WESTON, 1998c).
- *Decision Document for BRAC Parcels 8 through 13, Letterkenny Army Depot* (WESTON, 1998d).
- *Decision Document for BRAC Parcel 24, Letterkenny Army Depot* (WESTON, 1998e).
- *Decision Document for BRAC Railroad Parcels, Letterkenny Army Depot* (WESTON, 1998f).

The remedial action objectives for the Phase I Parcels in SE OU 8 are to:

- Prevent direct contact and ingestion of soil under residential and other nonindustrial exposure scenario.
- Prevent direct contact and ingestion of groundwater under any scenario.
- Prevent exposure levels of contaminants that produce unacceptable risk.

The remedial actions for the Phase I Parcels in SE OU 8 are:

- To restrict the property for commercial and industrial use only.
- To not permit soil excavation activities below a depth of 3 ft within the water table without prior approval of the Army.
- To not permit the construction of any subsurface structure for human occupation, without prior approval of the Army, EPA, and the PADEP.
- To restrict access or use of the groundwater underlying the property without the prior written approval of the Army, PADEP, and the EPA.
- To institute through an amendment to LEAD's Master Plan for the Phase I Parcels to reflect the institutional controls until the date of transfer.
- To implement the restrictions through the appropriate deed restrictions at the time of transfer.
- To establish periodic inspection procedures to ensure adherence to the institutional controls.

A Proposed Plan (PP) (WESTON, 2001a) was approved and a ROD (WESTON, 2001b) was signed in July 2001 for the Phase II Parcels. The ROD specified institutional controls as the final remedy for soils and the interim remedy for groundwater. The following areas comprise the SE Portions of Phase II: Parcels 2-35 through 2-77 (with the exception of Parcel 2-73). The locations of these parcels in the SE Area are shown in Figure 9.

The following documents were completed and approved to support the ROD for the Phase II Parcels in the SE Area:

- *Final Decision Document, Former PCB Transformer Sites in Southeastern (SE) Area, Operable Unit (OU) 8, (DSERTS Site LEAD-125)* (WESTON, 2000a).
- *Final Termination Survey Report for Building 441 at Letterkenny Army Depot* (WESTON, 2000b).
- *Remedial Investigation and Risk Assessment Report for the Gate 1 Guardhouse, Building 511, Southeastern Area (SE) Operable Unit (OU) 8, Letterkenny Army Depot.* Final Report (WESTON, 2001c).
- *Groundwater Vapor Intrusion Risk Assessment, Letterkenny Army Depot.* Final Report (WESTON, 2001d).
- *Feasibility Study Report for the Gate 1 Guardhouse, Building 511, Southeastern Area (SE) Operable Unit (OU) 8, Letterkenny Army Depot.* Final Report (WESTON, 2001e).
- *Seasonally High Groundwater Determination for the Phase 2 BRAC Parcels, Letterkenny Army Depot.* Final Report (EPSYS, 2001).

The remedial action objectives for the Phase II Parcels in SE OU 8 are to:

- Prevent direct contact and ingestion of soil under residential and other nonindustrial exposure scenario.
- Prevent direct contact and ingestion of groundwater under any scenario.
- Prevent exposure to levels of contaminants that produce unacceptable risk.

The remedial actions for the Phase II Parcels in SE OU 8 are:

- To restrict the property for commercial and industrial use only.
- To not permit soil excavation activities below a depth of 3 ft within the water table without prior approval of the Army.
- To not permit the construction of any subsurface structure for human occupation, without the prior approval of the Army, EPA and PADEP.
- To restrict access or use of the groundwater underlying the property without the prior written approval of the Army, EPA and PADEP.

- To institute through an amendment to LEAD's Master Plan for the Phase II Parcels to reflect the institutional controls until the date of transfer.
- To implement the restrictions through the appropriate deed restrictions at the time of transfer.

#### **4.8.2 Remedy Implementation**

Institutional controls were adopted by the Letterkenny Industrial Development Authority in October 1998 at the time of the Phase I Properties transfer. Permanent deed restrictions were placed on the Phase I Parcels restricting the use of the property to industrial and commercial; prohibiting the excavation of soil deeper than 3 ft above the water table without the prior approval of the Army; and restricting access to groundwater underlying the property without the prior written approval of the Army, PADEP, and EPA. The same approach is expected to be implemented at the time of property transfer of the Phase II Parcels.

#### **4.8.3 Operation and Maintenance**

The BRAC Cleanup Team is currently developing the vehicle by which the institutional controls will be monitored.

### **4.9 SE OU 9—LANDFILL J**

#### **4.9.1 Remedy Selection**

As of August 2001, no remedial action has been selected.

#### **4.9.2 Remedy Implementation**

Not applicable.

#### **4.9.3 Operation and Maintenance**

Not applicable.

### **4.10 SE OU 10—SSIA VOC-CONTAMINATED GROUNDWATER**

#### **4.10.1 Remedy Selection**

As of August 2001, no remedial action has been selected.

#### **4.10.2 Remedy Implementation**

Not applicable.

#### **4.10.3 Operation and Maintenance**

Not applicable.

### **4.11 SE OU 11—NSIA VOC-CONTAMINATED GROUNDWATER NORTH OF GATE 6**

#### **4.11.1 Remedy Selection**

As of August 2001, no remedial action has been implemented

#### **4.11.2 Remedy Implementation**

Not applicable.

#### **4.11.3 Operation and Maintenance**

Not applicable.

### **4.12 SE OU 12—LANDFILL G**

#### **4.12.1 Remedy Selection**

As of August 2001, no remedial action has been selected.

#### **4.12.2 Remedy Implementation**

Not applicable.

#### **4.12.3 Operation and Maintenance**

Not applicable.

## **5. FIVE-YEAR REVIEW FINDINGS**

### **5.1 FIVE-YEAR REVIEW PROCESS**

The 5-year review was led by Joe Petrasek, ER,A Project Manager, LEAD. The following team members assisted in the analysis and/or review:

- Bryan Hoke, BRAC Environmental Coordinator, LEAD
- Noreen Wagner, Project Manager, PADEP
- Stacie Driscoll, Project Manager, EPA Region III
- Paul Stone, Technical Manager, USACE

The following tasks were conducted as part of the five-year review process: document review, interviews, site inspection, ARARs review, and data review. There were no significant changes in the ARARs or site contaminants; therefore, site risks were not recalculated. The community was informed of the five-year review through the RAB meeting in August 1999.

### **5.2 INTERVIEWS**

An interview was conducted with Joseph Petrasek, ER,A Project Manager, Letterkenny Army Depot. The interview is presented in Appendix A of this document.

### **5.3 SITE INSPECTION**

An inspection conducted on 1 August 2001 (and subsequent video inspection of small animal burrows on 28 September 2001) indicated that the vegetative cover, the under drainage system, and the liner are intact. The cap inspection SOP plan calls for yearly inspections of the K-Area caps.

### **5.4 ARARS REVIEW**

As required by the NCP, selected remedies must be in compliance with all “applicable or relevant and appropriate requirements” (ARARs). ARARs are the cleanup standards, standards of control, and other substantive environmental requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance of a Superfund site. The ARARs for the site are reviewed in this section by OU.

**5.4.1 SE OU 1—K-Areas**

The ARARs have been reviewed for SE OU 1. Appendix B details the history and review of the ARARs for SE OU 1. Federal and State standards for the contaminants of concern have not changed in a manner that affects the protectiveness of the remedy.

**5.4.2 SE OU 2—Industrial Wastewater Sewer System**

Any action planned for this OU in the future will meet ARARs and be protective of human health and the environment.

**5.4.3 SE OU 3—Disposal Area VOC-Contaminated Groundwater**

Any action planned for this OU in the future will meet ARARs and be protective of human health and the environment.

**5.4.4 SE OU 4—Stormwater Sewer Lines and Associated Drainageways**

Any action planned for this OU in the future will meet ARARs and be protective of human health and the environment.

**5.4.5 SE OU 5—Areas A and B Contaminated Soils**

Any action planned for this OU in the future will meet ARARs and be protective of human health and the environment.

**5.4.6 SE OU 6—SE Area Offpost Contaminated Groundwater**

Any action planned for this OU in the future will meet ARARs and be protective of human health and the environment.

**5.4.7 SE OU 7—Truck Open Storage Area**

Any action planned for this OU in the future will meet ARARs and be protective of human health and the environment.

**5.4.8 SE OU 8—BRAC Waste Sites**

The institutional controls and deed provisions for the Phase I and Phase II Parcels in SE OU 8 are protective of human health and the environment.

**5.4.9 SE OU 9—Landfill J**

Any action planned for this OU in the future will meet ARARs and be protective of human health and the environment.

**5.4.10 SE OU 10—SSIA VOC-Contaminated Groundwater**

Any action planned for this OU in the future will meet ARARs and be protective of human health and the environment.

**5.4.11 SE OU 11—NSIA VOC-Contaminated Groundwater North of Gate 6**

Any action planned for this OU in the future will meet ARARs and be protective of human health and the environment.

**5.4.12 SE OU 12—Landfill G**

Any action planned for this OU in the future will meet ARARs and be protective of human health and the environment.

## **6. ASSESSMENT**

### **6.1 SE OU 1—K-AREAS**

The remedy selected for SE OU 1 remains protective of human health and the environment based on continued industrial use. This determination is supported by the conclusions presented in this section.

#### **6.1.1 Effectiveness of Remedy**

The Low Temperature Thermal Treatment was effective in meeting the remedial action objectives, which are to prevent direct contact and ingestion of soil; and reduce exposure levels of contaminants that produce unacceptable risk.

#### **6.1.2 Adequacy and Continued Need for O&M**

An inspection of the cap conducted on 1 August 2001 (and subsequent video inspection of small animal burrows on 28 September 2001) indicated that the vegetative cover, drainage system, and liner are intact. The Cap Inspection Plan recommends yearly inspections of the K-Area caps.

#### **6.1.3 Indicators of Potential Remedy Failure**

There are no early indicators of remedy failure.

#### **6.1.4 Achievement of Remedial Action Objectives/Cleanup Levels**

The Low Temperature Thermal Treatment met the remedial action objectives for SE OU 1.

#### **6.1.5 Opportunities for Optimization**

There are currently no opportunities for optimization for SE OU 1.

#### **6.1.6 Changes in ARARs or Other Risk-Related Factors**

There are no changes in ARARs or other risk-related factors for SE OU 1 (see Appendix B).

#### **6.1.7 Changes in Known Contaminants, Sources, or Pathways at the Site**

There have been no changes in known contaminants, sources, or pathways at SE OU 1.

## **6.2 SE OU 2—INDUSTRIAL WASTEWATER SEWER SYSTEM**

### **6.2.1 Effectiveness of Remedy**

As of August 2001, the remedy for SE OU 2 has not been selected.

### **6.2.2 Adequacy and Continued Need for O&M**

Not applicable.

### **6.2.3 Indicators of Potential Remedy Failure**

Not applicable.

### **6.2.4 Achievement of Remedial Action Objectives/Cleanup Levels**

Not applicable.

### **6.2.5 Opportunities for Optimization**

Not applicable.

### **6.2.6 Changes in ARARs or Other Risk-Related Factors**

Not applicable.

### **6.2.7 Changes in Known Contaminants, Sources, or Pathways at the Site**

Not applicable.

## **6.3 SE OU 3—DISPOSAL AREA VOC-CONTAMINATED GROUNDWATER**

### **6.3.1 Effectiveness of Remedy**

As of August 2001, the remedy for SE OU 3 has not been selected.

### **6.3.2 Adequacy and Continued Need for O&M**

Not applicable.

**6.3.3 Indicators of Potential Remedy Failure**

Not applicable.

**6.3.4 Achievement of Remedial Action Objectives/Cleanup Levels**

Not applicable.

**6.3.5 Opportunities for Optimization**

Not applicable.

**6.3.6 Changes in ARARs or Other Risk-Related Factors**

Not applicable.

**6.3.7 Changes in Known Contaminants, Sources, or Pathways at the Site**

Not applicable.

**6.4 SE OU 4—STORMWATER SEWER LINES AND ASSOCIATED DRAINAGEWAYS****6.4.1 Effectiveness of Remedy**

As of August 2001, the remedy for SE OU 4 has not been selected.

**6.4.2 Adequacy and Continued Need for O&M**

Not applicable.

**6.4.3 Indicators of Potential Remedy Failure**

Not applicable.

**6.4.4 Achievement of Remedial Action Objectives/Cleanup Levels**

Not applicable.

**6.4.5 Opportunities for Optimization**

Not applicable.

**6.4.6 Changes in ARARs or Other Risk-Related Factors**

Not applicable.

**6.4.7 Changes in Known Contaminants, Sources, or Pathways at the Site**

Not applicable.

**6.5 SE OU 5—AREA A AND B CONTAMINATED SOILS****6.5.1 Effectiveness of Remedy**

As of August 2001, the remedy for SE OU 5 has not been selected.

**6.5.2 Adequacy and Continued Need for O&M**

Not applicable.

**6.5.3 Indicators of Potential Remedy Failure**

Not applicable.

**6.5.4 Achievement of Remedial Action Objectives/Cleanup Levels**

Not applicable.

**6.5.5 Opportunities for Optimization**

Not applicable.

**6.5.6 Changes in ARARs or Other Risk-Related Factors**

Not applicable.

### **6.5.7 Changes in Known Contaminants, Sources, or Pathways at the Site**

Not applicable.

## **6.6 SE OU 6—SE AREA OFFPOST CONTAMINATED GROUNDWATER**

### **6.6.1 Effectiveness of Remedy**

As of August 2001, the remedy for SE OU 6 has not been selected.

### **6.6.2 Adequacy and Continued Need for O&M**

Not applicable.

### **6.6.3 Indicators of Potential Remedy Failure**

Not applicable.

### **6.6.4 Achievement of Remedial Action Objectives/Cleanup Levels**

Not applicable.

### **6.6.5 Opportunities for Optimization**

Not applicable.

### **6.6.6 Changes in ARARs or Other Risk-Related Factors**

Not applicable.

### **6.6.7 Changes in Known Contaminants, Sources, or Pathways at the Site**

Not applicable.

## **6.7 SE OU 7—TRUCK OPEN STORAGE AREA**

### **6.7.1 Effectiveness of Remedy**

As of August 2001, the remedy for SE OU 7 has not been selected.

**6.7.2 Adequacy and Continued Need for O&M**

Not applicable.

**6.7.3 Indicators of Potential Remedy Failure**

Not applicable.

**6.7.4 Achievement of Remedial Action Objectives/Cleanup Levels**

Not applicable.

**6.7.5 Opportunities for Optimization**

Not applicable.

**6.7.6 Changes in ARARs or Other Risk-Related Factors**

Not applicable.

**6.7.7 Changes in Known Contaminants, Sources, or Pathways at the Site**

Not applicable.

**6.8 SE OU 8—BRAC WASTE SITES****6.8.1 Effectiveness of Remedy**

The institutional controls are effective in meeting the remedial action objectives for the SE OU 8 Phase I and Phase II Transfer Parcels, which are to prevent direct contact and ingestion of soil under residential and other nonindustrial exposure scenarios; prevent direct contact and ingestion of groundwater under any scenario and; reduce exposure levels of contaminants that produce unacceptable risk.

**6.8.2 Adequacy and Continued Need for O&M**

The O&M requirements for the Phase I and Phase II parcels of this OU, which will be documented in an Institutional Control (IC) Memorandum of Agreement (MOA), are currently being prepared by the Letterkenny BRAC Cleanup Team.

**6.8.3 Indicators of Potential Remedy Failure**

There are no early indicators of remedy failure.

**6.8.4 Achievement of Remedial Action Objectives/Cleanup Levels**

The remedy for the SE OU 8 Phase I and Phase II Transfer Parcels continues to achieve the remedial action objectives.

**6.8.5 Opportunities for Optimization**

There are currently no opportunities for optimization for the SE OU 8 Phase I and Phase II Transfer Parcels.

**6.8.6 Changes in ARARs or Other Risk-Related Factors**

There are no changes in ARARs or other risk-related factors for the SE OU 8 Phase I and Phase II Transfer Parcels.

**6.8.7 Changes in Known Contaminants, Sources, or Pathways at the Site**

There have been no changes in known contaminants, sources, or pathways at the SE OU 8 Phase I and Phase II Transfer Parcels.

**6.9 SE OU 9—LANDFILL J****6.9.1 Effectiveness of Remedy**

As of 1 August 2001, the remedy for SE OU 9 has not been selected.

**6.9.2 Adequacy and Continued Need for O&M**

Not applicable.

**6.9.3 Indicators of Potential Remedy Failure**

Not applicable.

**6.9.4 Achievement of Remedial Action Objectives/Cleanup Levels**

Not applicable.

**6.9.5 Opportunities for Optimization**

Not applicable.

**6.9.6 Changes in ARARs or Other Risk-Related Factors**

Not applicable.

**6.9.7 Changes in Known Contaminants, Sources, or Pathways at the Site**

Not applicable.

**6.10 SE OU 10—SSIA VOC-CONTAMINATED GROUNDWATER****6.10.1 Effectiveness of Remedy**

As of August 2001, the remedy for SE OU 10 has not been selected.

**6.10.2 Adequacy and Continued Need for O&M**

Not applicable.

**6.10.3 Indicators of Potential Remedy Failure**

Not applicable.

**6.10.4 Achievement of Remedial Action Objectives/Cleanup Levels**

Not applicable.

**6.10.5 Opportunities for Optimization**

Not applicable.

**6.10.6 Changes in ARARs or Other Risk-Related Factors**

Not applicable.

**6.10.7 Changes in Known Contaminants, Sources, or Pathways at the Site**

Not applicable.

**6.11 SE OU 11—NSIA VOC-CONTAMINATED GROUNDWATER NORTH OF GATE 6****6.11.1 Effectiveness of Remedy**

As of August 2001, the remedy for SE OU 11 has not been selected.

**6.11.2 Adequacy and Continued Need for O&M**

Not applicable.

**6.11.3 Indicators of Potential Remedy Failure**

Not applicable.

**6.11.4 Achievement of Remedial Action Objectives/Cleanup Levels**

Not applicable.

**6.11.5 Opportunities for Optimization**

Not applicable.

**6.11.6 Changes in ARARs or Other Risk-Related Factors**

Not applicable.

**6.11.7 Changes in Known Contaminants, Sources, or Pathways at the Site**

Not applicable.

**6.12 SE OU 12—LANDFILL G****6.12.1 Effectiveness of Remedy**

As of August 2001, the remedy for SE OU 12 has not been selected.

**6.12.2 Adequacy and Continued Need for O&M**

Not applicable.

**6.12.3 Indicators of Potential Remedy Failure**

Not applicable.

**6.12.4 Achievement of Remedial Action Objectives/Cleanup Levels**

Not applicable.

**6.12.5 Opportunities for Optimization**

Not applicable.

**6.12.6 Changes in ARARs or Other Risk-Related Factors**

Not applicable.

**6.12.7 Changes in Known Contaminants, Sources, or Pathways at the Site**

Not applicable.

## 7. DEFICIENCIES

The deficiencies identified during the five-year review are noted in the Table below. These deficiencies are not considered by the Army to be sufficient to warrant a finding that the remedy is not protective as long as corrective actions are implemented in a timely manner with respect to each deficiency.

Deficiencies	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
<b>Institutional Controls</b>		
Institutional Controls to restrict the use of the K Areas OU were not a component of the remedy	N	Y
<b>Cap Integrity</b>		
Evidence of small animal burrows at a few locations on the surface of the cap. (Note: Based on the findings of the 28 September 2001 video inspection, the burrows do not breach through the cap)	N	N

## 8. RECOMMENDATIONS AND REQUIRED ACTIONS

SE OU 1—K-Areas: The original ROD called for excavation, treatment, and management of treated soils. The remedy provided cleanup to industrial-based cleanup levels, but did not include institutional controls. Current EPA policy requires that institutional controls need to be implemented for those areas where the remedy does not clean up to the most conservative (i.e., residential) standards for human health risk. In addition, the original ROD and original ESD reference capping the area in accordance with Pennsylvania Residual Waste Regulations; however, this does not include cap maintenance as part of the site Operation and Maintenance Plan. This five-year review has resulted in identifying these issues. An ESD will be prepared as a result of this review to address institutional controls and cap maintenance.

SE OU 2—Industrial Wastewater Sewer System: Once the remedy for SE OU 2 has been determined, long-term monitoring and O&M will need to be evaluated.

SE OU 3—Disposal Area VOC-Contaminated Groundwater: Once the remedy for SE OU 3 has been determined, long-term monitoring and O&M will need to be evaluated.

SE OU 4—Stormwater Sewer Lines and Associated Drainageways: Once the remedy for SE OU 4 has been determined, long-term monitoring and O&M will need to be evaluated.

SE OU 5—Area A and B Contaminated Soils: Once the remedy for SE OU 5 has been determined, long-term monitoring and O&M will need to be evaluated.

SE OU 6—SE Area Offpost Contaminated Groundwater: Once the remedy for SE OU 6 has been determined, long-term monitoring and O&M will need to be evaluated.

SE OU 7—Truck Open Storage Area: Once the remedy for SE OU 7 has been determined, long-term monitoring and O&M will need to be evaluated.

SE OU 8—BRAC Waste Sites: Based upon a comprehensive review of available site data, the implemented remedies appear to be protective of human health and the environment, and no additional action, besides continuing current institutional controls, is recommended at this time.

SE OU 9—Landfill J: Once the remedy for SE OU 9 has been determined, long-term monitoring and O&M will need to be evaluated.

SE OU 10—SSIA VOC-Contaminated Groundwater: Once the remedy for SE OU 10 has been determined, long-term monitoring and O&M will need to be evaluated.

SE OU 11—NSIA VOC-Contaminated Groundwater North of Gate 6: Once the remedy for SE OU 11 has been determined, long-term monitoring and O&M will need to be evaluated.

SE OU 12—Landfill G: Once the remedy for SE OU 12 has been determined, long-term monitoring and O&M will need to be evaluated.

## 9. PROTECTIVENESS STATEMENT

The remedy at SE OU 1 is protective of human health and the environment under current industrial land use. Long-term protectiveness of the remedial action is expected upon implementation of institutional controls. The remedies for SE OU 2, SE OU 3, SE OU 4, SE OU 5, SE OU 6, SE OU 7, SE OU 8, SE OU 9, SE OU 10, SE OU 11 and SE OU 12 have not been selected.

SE OU 2—Industrial Wastewater Sewer System: The remedy for SE OU 2 has not been selected at this time. It is anticipated that all remedial actions selected for SE OU 2 will be protective of human health and the environment.

SE OU 3—Disposal Area VOC-Contaminated Groundwater: The remedy for SE OU 3 has not been selected at this time. It is anticipated that all remedial actions selected for SE OU 3 will be protective of human health and the environment.

SE OU 4—Stormwater Sewer Lines and Associated Drainageways: The remedy for SE OU 4 has not been selected at this time. It is anticipated that all remedial actions selected for SE OU 4 will be protective of human health and the environment.

SE OU 5—Area A and B Contaminated Soils: The remedy for SE OU 5 has not been selected at this time. It is anticipated that all remedial actions selected for SE OU 5 will be protective of human health and the environment.

SE OU 6—SE Area Offpost Contaminated Groundwater: The remedy for SE OU 6 has not been selected at this time. It is anticipated that all remedial actions selected for SE OU 6 will be protective of human health and the environment.

SE OU 7—Truck Open Storage Area: The remedy for SE OU 7 has not been selected at this time. It is anticipated that all remedial actions selected for SE OU 7 will be protective of human health and the environment.

SE OU 8—BRAC Waste Sites: The remedy for SE OU 8 Phase I and Phase II Parcels is protective of human health and the environment.

SE OU 9—Landfill J: The remedy for SE OU 9 has not been selected at this time. It is anticipated that all remedial actions selected for SE OU 9 will be protective of human health and the environment.

SE OU 10—SSIA VOC-Contaminated Groundwater: The remedy for SE OU 10 has not been selected at this time. It is anticipated that all remedial actions selected for SE OU 10 will be protective of human health and the environment.

SE OU 11—NSIA VOC-Contaminated Groundwater North of Gate 6: The remedy for SE OU 11 has not been selected at this time. It is anticipated that all remedial actions selected for SE OU 11 will be protective of human health and the environment.

**SECTION 9—PROTECTIVENESS STATEMENT**

SE OU 12—Landfill G: The remedy for SE OU 12 has not been selected at this time. It is anticipated that all remedial actions selected for SE OU 12 will be protective of human health and the environment.

## 10. NEXT FIVE-YEAR REVIEW

This is a statutory site that requires ongoing five-year reviews. Based on the initial trigger date of 8 September 1993, the next five-year review for SE OU 1 will be completed no later than 3 September 2003.

## 11. REFERENCES

- Acker, R.C. 1955. *Water Supply from Wells for Letterkenny Ordnance Works*. Letter Report to District Engineer, U.S. Army Corps of Engineers, Baltimore District.
- Becher, A.E., and L.E. Taylor. 1982. *Groundwater Resources in the Cumberland and Contiguous Valleys of Franklin County, Pennsylvania*. Pennsylvania Geological Survey Water Resources Report 53. Harrisburg, Pennsylvania.
- EA (EA Engineering, Science, and Technology). 1991. *Site Investigation, LEAD*.
- EPA (U.S. Environmental Protection Agency). June 2001. *Comprehensive Five-Year Review Guidance*. Directive 9355.7-03B-P. Office of Emergency and Remedial Response.
- EPSYS (Epsys Corporation). 2001. *Seasonally High Groundwater Determination for the Phase 2 BRAC Parcels, Letterkenny Army Depot*. Final Report.
- ERM (Environmental Resources Management, Inc.). 1995. *Letterkenny Army Depot – SWMU Site Investigation Follow-on Report*, ELIN A009. January 1995.
- ESE (Environmental Science & Engineering, Inc.). June 1993. *Remedial Investigation of the Southeastern Area at Letterkenny Army Depot. Final Report*.
- USATHAMA (U.S. Army Toxic and Hazardous Materials Agency). 1980. *Installation Assessment of Letterkenny Army Depot, Report No. 16, Aberdeen Proving Ground, Maryland*.
- USACE, 2000. SE OU 1 (K-Areas) Vegetative Cover Preventative Maintenance and Corrective Action Standard Operating Procedure.
- WESTON (Roy F. Weston, Inc.). 1984. *LEAD Remedial Investigation and Feasibility Study*. West Chester, Pennsylvania.
- WESTON (Roy F. Weston, Inc.). 1998a. *Proposed Plan for Phase I Parcels, Letterkenny Army Depot*. March 1998.
- WESTON (Roy F. Weston, Inc.). 1998b. *Record of Decision for Phase I parcels, Letterkenny Army Depot*. September 1998.
- WESTON (Roy F. Weston, Inc.). 1998c. *Decision Document for BRAC Parcels 1 and 2, Letterkenny Army Depot*.
- WESTON (Roy F. Weston, Inc.). 1998d. *Decision Document for BRAC Parcels 8 through 13, Letterkenny Army Depot*.
- WESTON (Roy F. Weston, Inc.). 1998e. *Decision Document for BRAC Parcel 24, Letterkenny Army Depot*.

WESTON (Roy F. Weston, Inc.). 1998f. *Decision Document for BRAC Railroad Parcels, Letterkenny Army Depot.*

WESTON (Roy F. Weston, Inc.). 2000a. *Final Decision Document, Former PCB Transformer Sites in Southeastern (SE) Area, Operable Unit (OU) 8, (DSERTS Site LEAD-125).*

WESTON (Roy F. Weston, Inc.). 2000b. *Final Termination Survey Report for Building 441 at Letterkenny Army Depot.*

WESTON (Roy F. Weston, Inc.). 2001a. *Proposed Plan for Phase II Parcels, Letterkenny Army Depot.* February 2001.

WESTON (Roy F. Weston, Inc.). 2001b. *Record of Decision for Phase II Parcels, Letterkenny Army Depot.* July 2001.

WESTON (Roy F. Weston, Inc.). 2001c. *Remedial Investigation and Risk Assessment Report for the Gate 1 Guardhouse, Building 511, Southeastern Area (SE) Operable Unit (OU) 8, Letterkenny Army Depot.* Final Report.

WESTON (Roy F. Weston, Inc.). 2001d. *Groundwater Vapor Intrusion Risk Assessment, Letterkenny Army Depot.* Final Report.

WESTON (Roy F. Weston, Inc.). 2001e. *Feasibility Study Report for the Gate 1 Guardhouse, Building 511, Southeastern Area (SE) Operable Unit (OU) 8, Letterkenny Army Depot.* Final Report.

# Figures

**U.S. Army Corps of Engineers  
Baltimore District  
Letterkenny Army Depot  
Chambersburg, Pennsylvania**

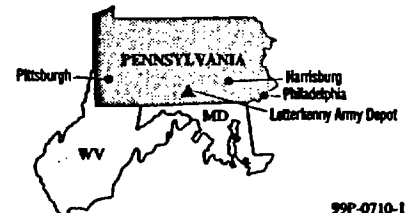
**FIGURE 1**  
**PROPERTY LOCATION**

Property location shown in black. Base map image adapted from the U.S. Geological Survey 30x60 minute quadrangle maps, Carlisle, PA (photo inspected 1985) and Hagerstown, MD, PA, WV (1983).

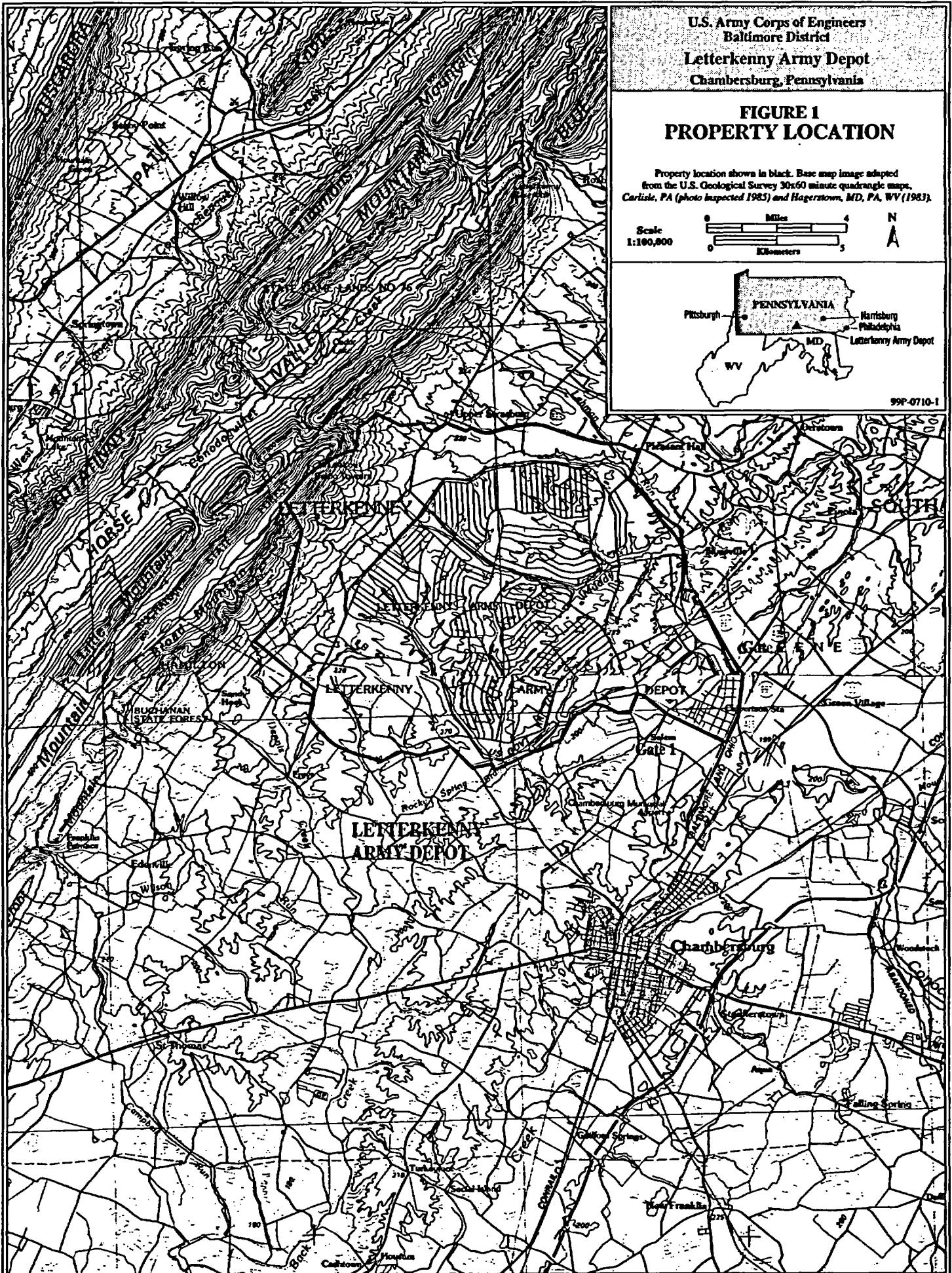
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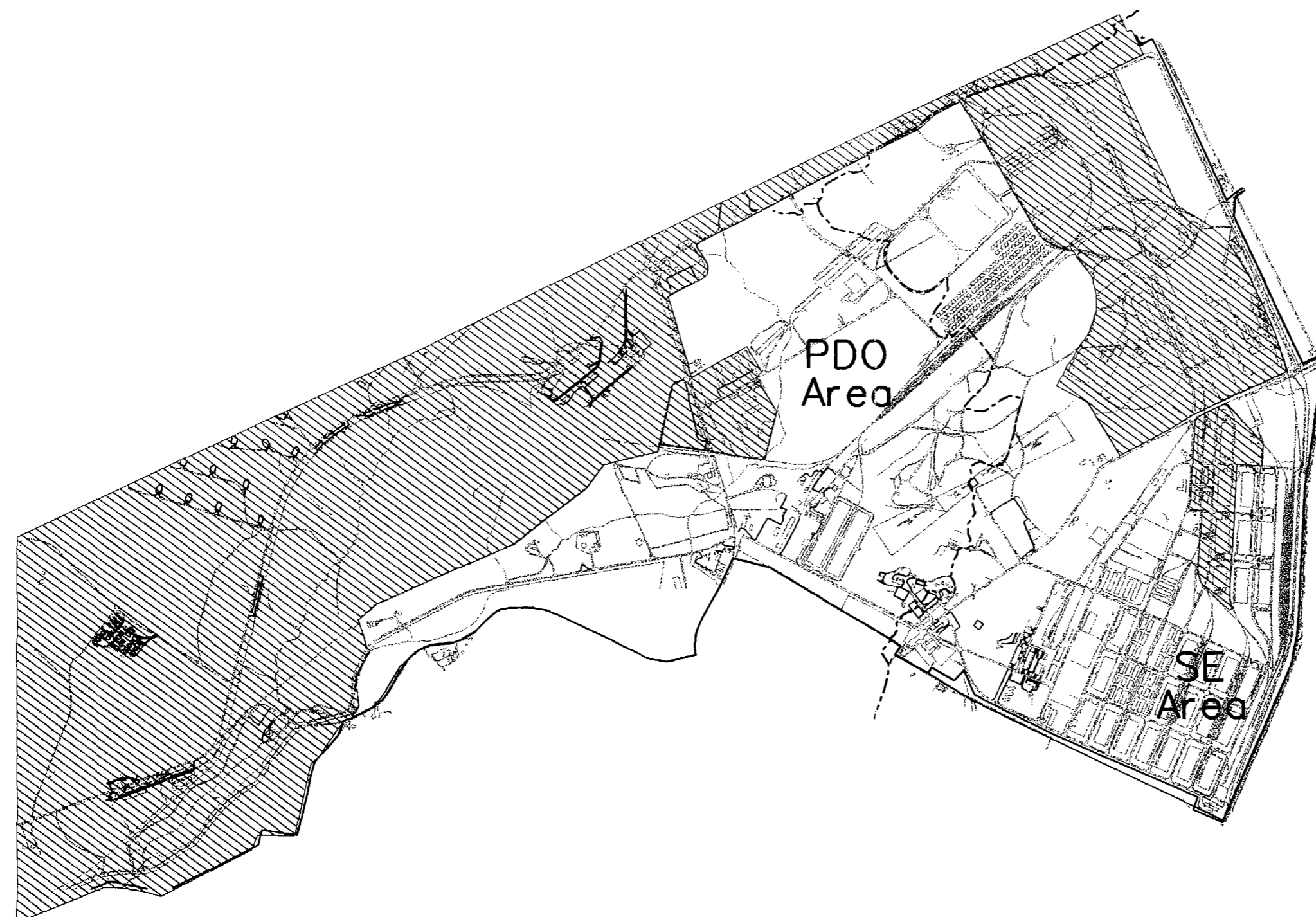
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## **FIGURES**

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**LEGEND:**



Buildings



Roads



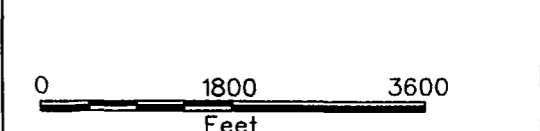
Drainage



Enclave Area



Dividing Line Between  
SE and PDO Areas



Letterkenny Army Depot  
Chambersburg, PA

Figure 2  
Location of SE and PDO Areas  
at Letterkenny Army Depot



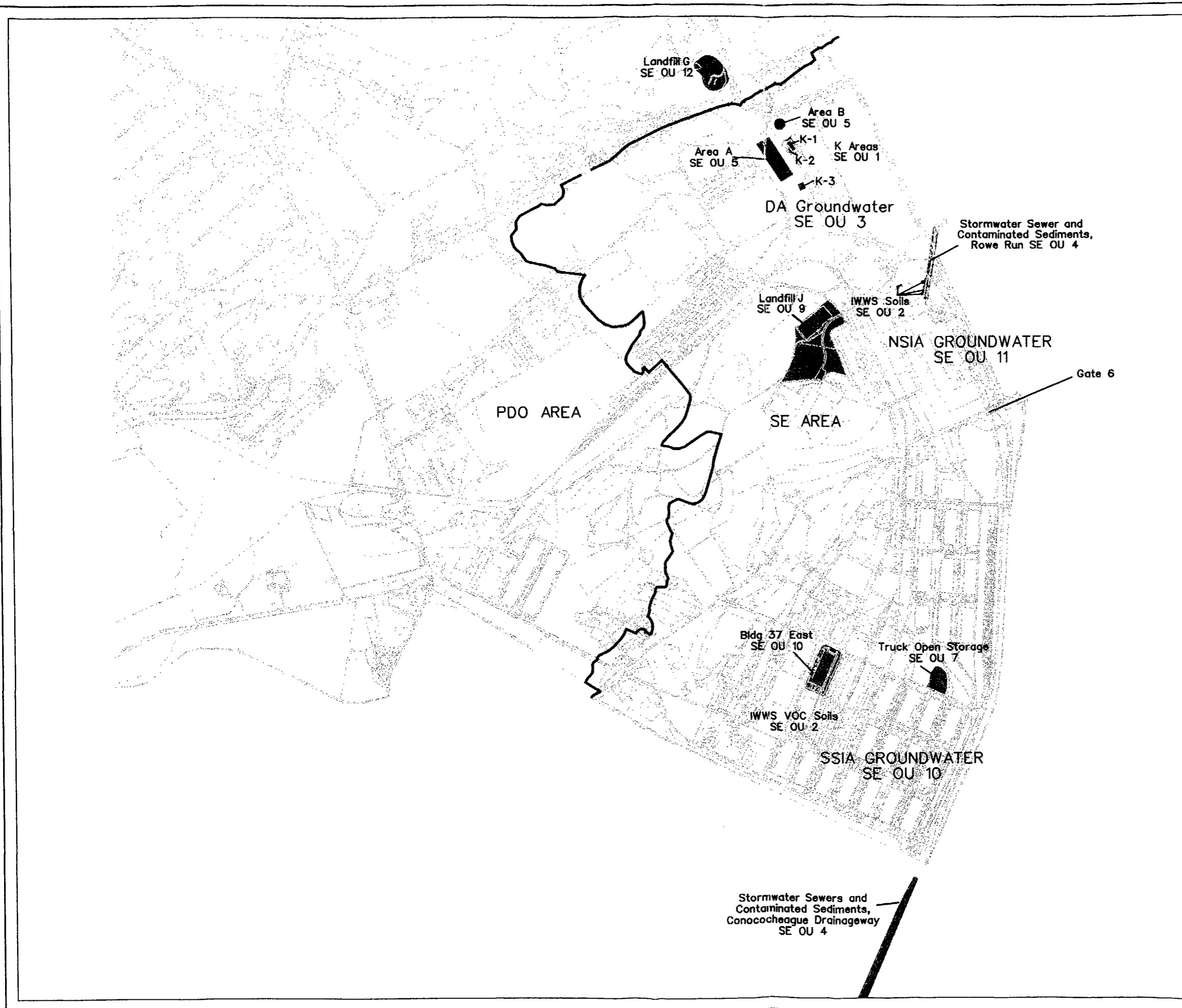
U.S. Army Corps of Engineers  
Baltimore District



**WESTON**  
MANAGERS DESIGNERS/CONSULTANTS

Date:  
09-28-2001

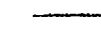
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# **LEGEND:**



Buildings



Roads



Operable Unit Location  
(approximate)



Dividing Line Between  
SE and PDO Areas

## **Note:**

1. SE OU 6 is off-post contaminated groundwater beyond SE OU 3 and SE OU 11 and is not shown on this map.
2. SE OU 2 (IWWS and associated contaminated soils) is located throughout the Southeast Industrial Area and the sewer lines are not specifically identified.
3. SE OU 3 and SE OU 11 are both on-site groundwater OUs. SE OU 3 is the DA Area VOC-Contaminated Groundwater. SE OU 11 is the NSIA VOC-Contaminated Groundwater (IWTP Lagoons Area and Industrial Sewers) located north of Gate 6 (Both Susquehanna Drainage Basins).
4. SE OU 10 is located south of Gate 6 (Potomac Drainage Basin). SE OU 10 consists of on-site and off-site VOC-Contaminated groundwater.
5. The aerial extent of SE OU 3, SE OU 10 and SE OU 11 is shown on Figure 4, and SE OU 8 sites are shown in Figure 5.

0 1400 2800  
Feet



**Letterkenny Army Depot  
Chambersburg, PA**

**Figure 3  
Locations of Operable Units  
in the SE Area at  
Letterkenny Army Depot**

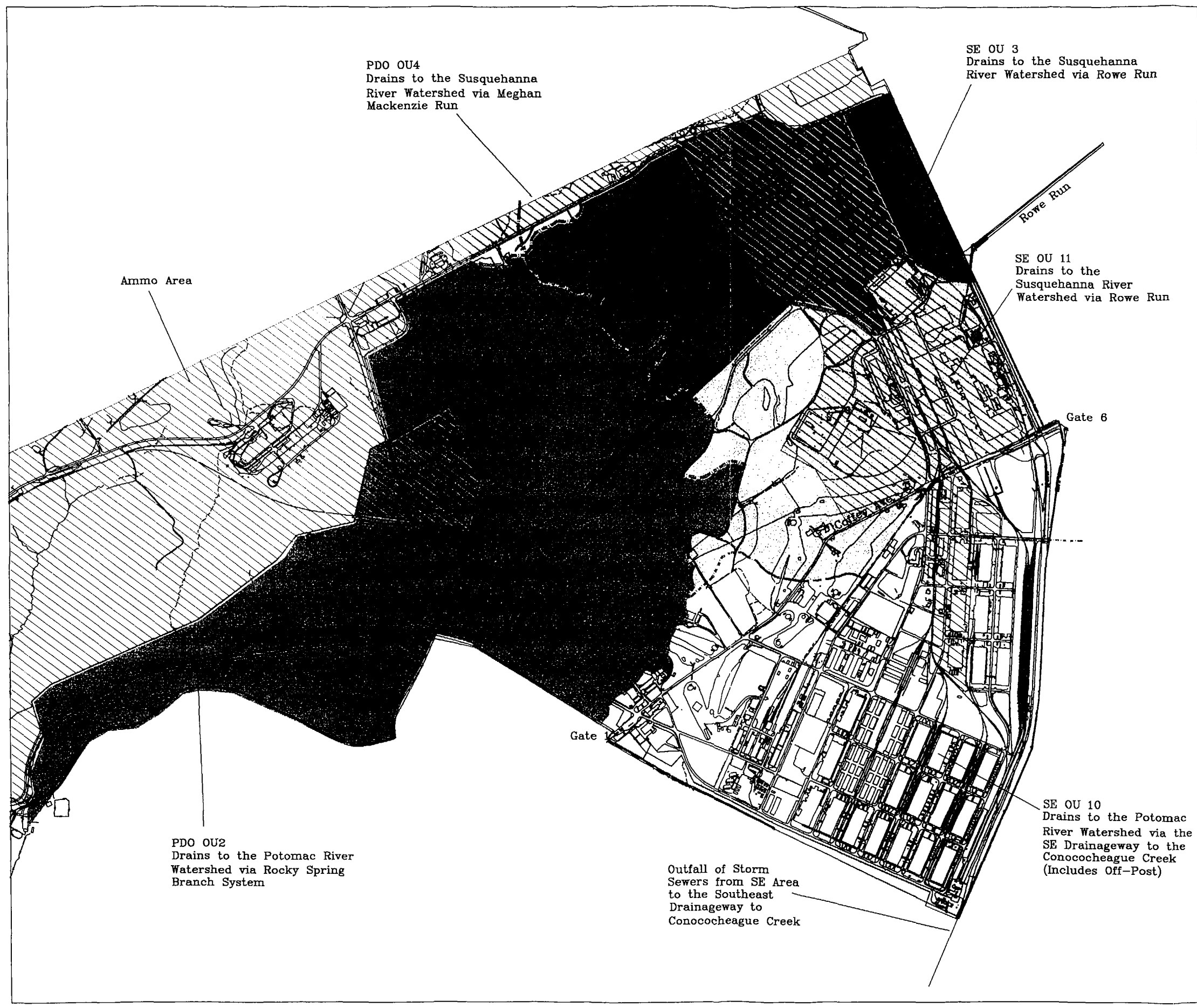


U.S. Army Corps of Engineers  
Baltimore District



**WESTON**  
MANAGERS DESIGNERS CONSULTANTS

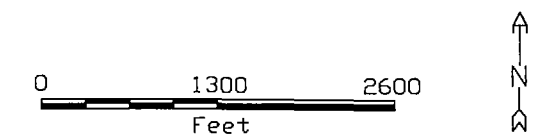
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**LEGEND:**

- Drainage
- ▨ Enclave Area
- - - Major Watershed Divide
- · · Subbasin Drainage Divide
- SE OU 3: Disposal Area VOC-Contaminated Groundwater
- SE OU 10: Southern Southeast Industrial Area VOC-Contaminated Groundwater South of Gate 6 (Conococheague Drainage System)
- SE OU 11: Northern Southeast Industrial Area VOC-Contaminated Groundwater North of Gate 6
- PDO OU 2: PDO Area Groundwater and Surface Water
- PDO OU 4: Groundwater Associated with the PDO Oil Burn Pit

Note: SE OU 6 (not shown) is SE Area Off-Post VOC-Contaminated Groundwater (beyond boundaries of SE OU 3 and SE OU 11)



**Letterkenny Army Depot  
Chambersburg, PA**

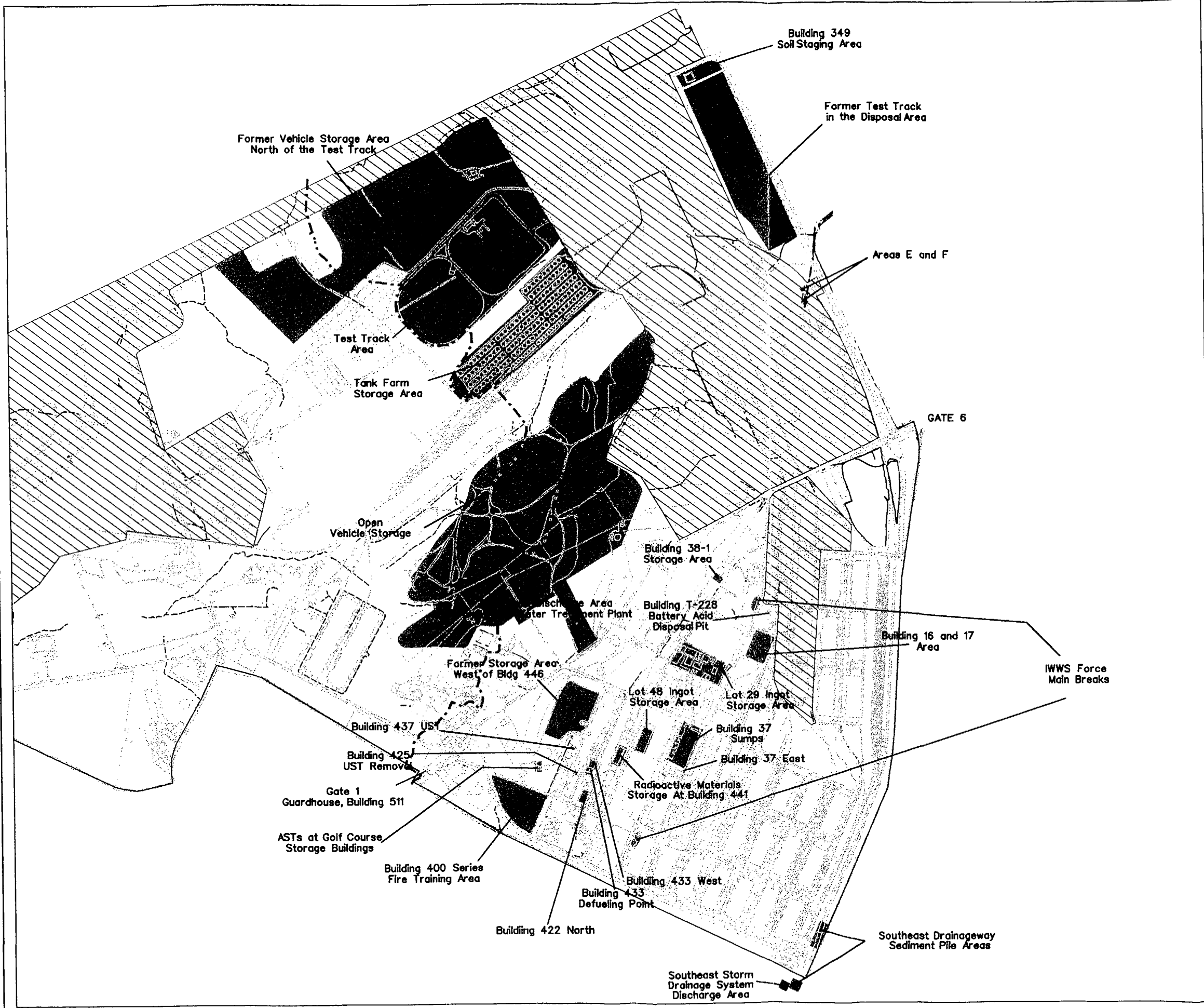
**Figure 4  
Location of On-base  
Groundwater  
Operable Units (OUs)  
Letterkenny Army Depot**









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Baltimore District



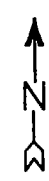
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**LEGEND:**

-  Buildings
-  Roads
-  Drainage
-  SE OU 8 Investigation Area (approximate)
-  Dividing Line Between SE and PDO Areas
-  Enclave Area

0 1210 2420  
Feet



**Letterkenny Army Depot  
Chambersburg, PA**

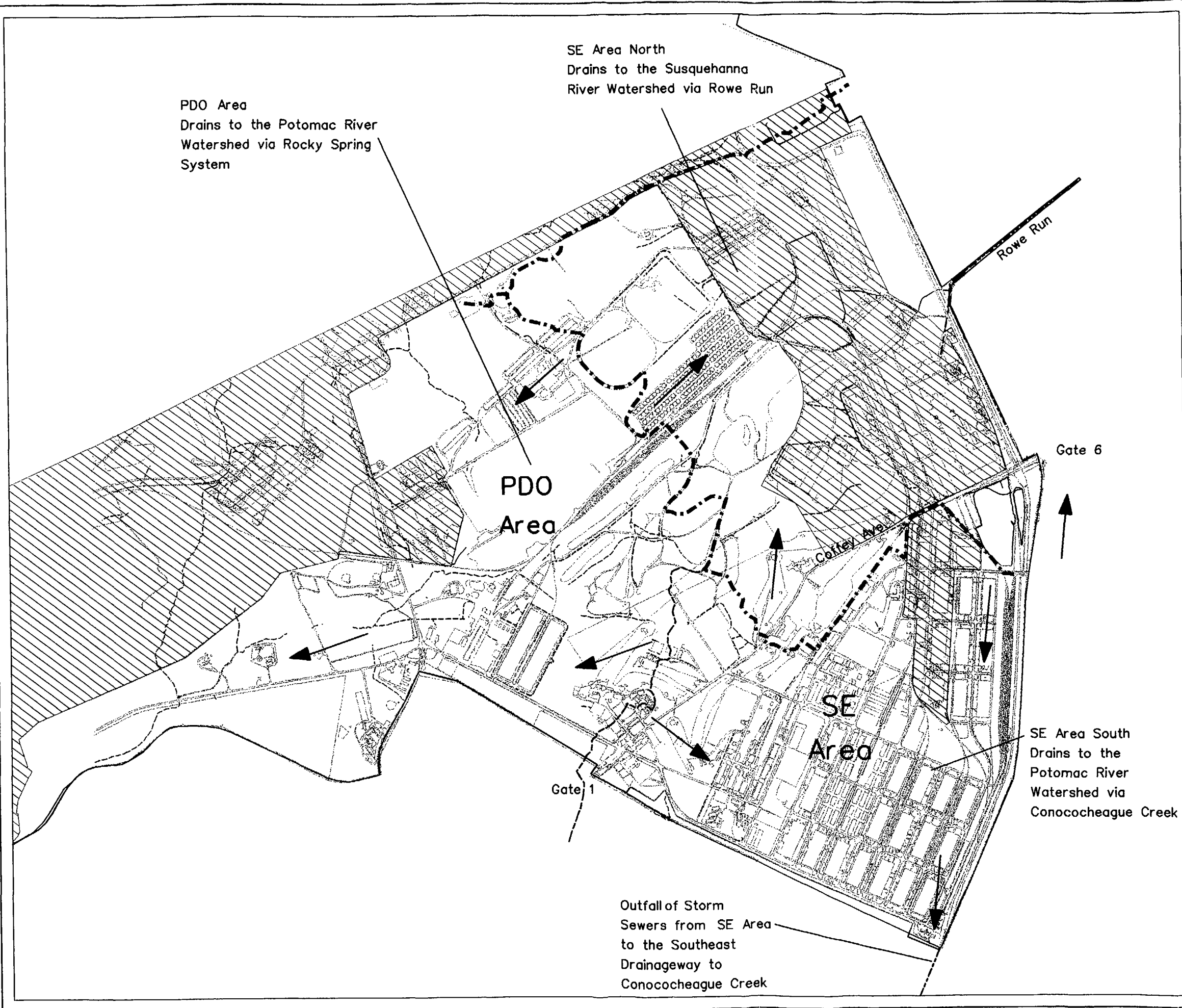
**Figure 5  
SE OU 8 BRAC  
Investigation Sites**








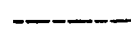

U.S. Army Corps of Engineers  
Baltimore District

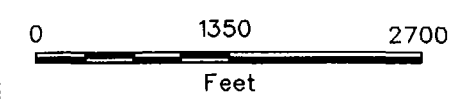


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**LEGEND:**

-  Buildings
-  Roads
-  Drainage
-  Enclave Area
-  Major Watershed Divide
-  Subbasin Drainage Divide
-  General Flow Direction



**Letterkenny Army Depot  
Chambersburg, PA**

**Figure 6  
Location of Drainageways and  
Drainage Divides at LEAD**









U.S. Army Corps of Engineers  
Baltimore District



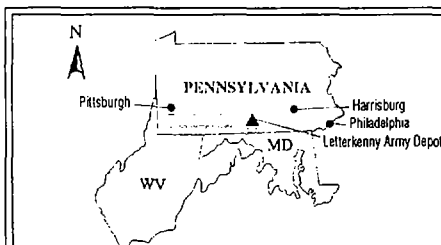
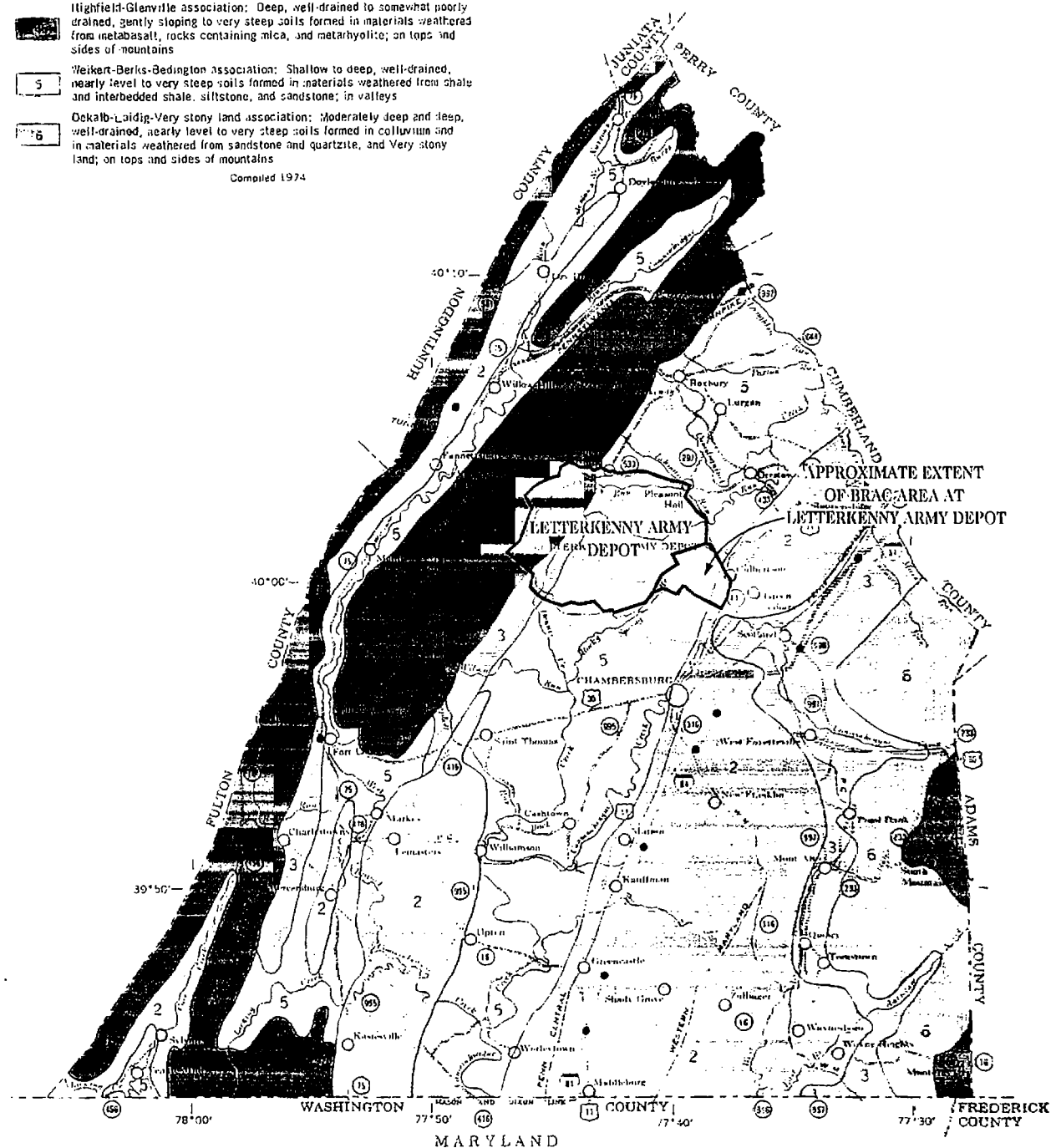
Date:  
09-28-2001

# SOIL ASSOCIATIONS

Scale 1:253,440  
0 1 2 3 4 Miles

-  Laidig-Very stony land-Buchanan association: Deep, well drained to somewhat poorly drained, nearly level to very steep soils formed in colluvium from sandstone, and Very stony land; on tops and sides of mountains
-  Hagerstown-Duffield association: Deep, well-drained, nearly level to steep soils formed in materials weathered from limestone; in valleys
-  Murrill-Laidig association: Deep, well-drained, gently sloping to moderately steep soils formed in colluvium; on mountain foot slopes
-  Highfield-Glenville association: Deep, well-drained to somewhat poorly drained, gently sloping to very steep soils formed in materials weathered from metabasalt, rocks containing mica, and metarhyolite; on tops and sides of mountains
-  Weikert-Berks-Bedington association: Shallow to deep, well-drained, nearly level to very steep soils formed in materials weathered from shale and interbedded shale, siltstone, and sandstone; in valleys
-  Dekalb-Laidig-Very stony land association: Moderately deep and deep, well-drained, nearly level to very steep soils formed in colluvium and in materials weathered from sandstone and quartzite, and Very stony land; on tops and sides of mountains

Compiled 1974

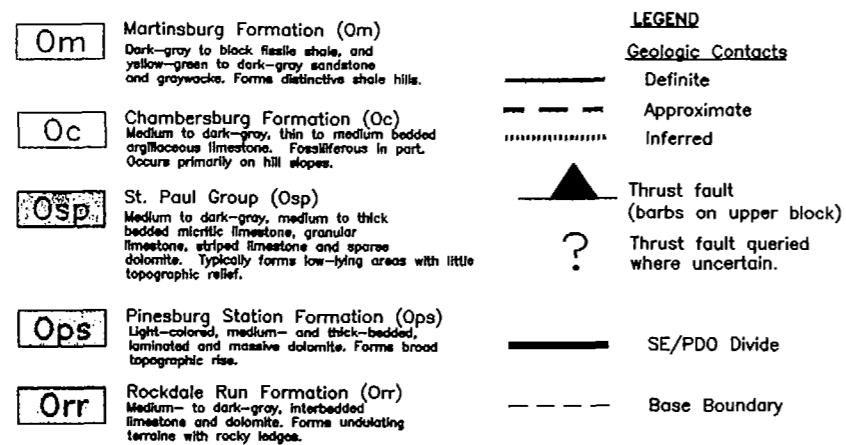


U.S. Army Corps of Engineers,  
Baltimore District  
Letterkenny Army Depot  
Chambersburg, Pennsylvania

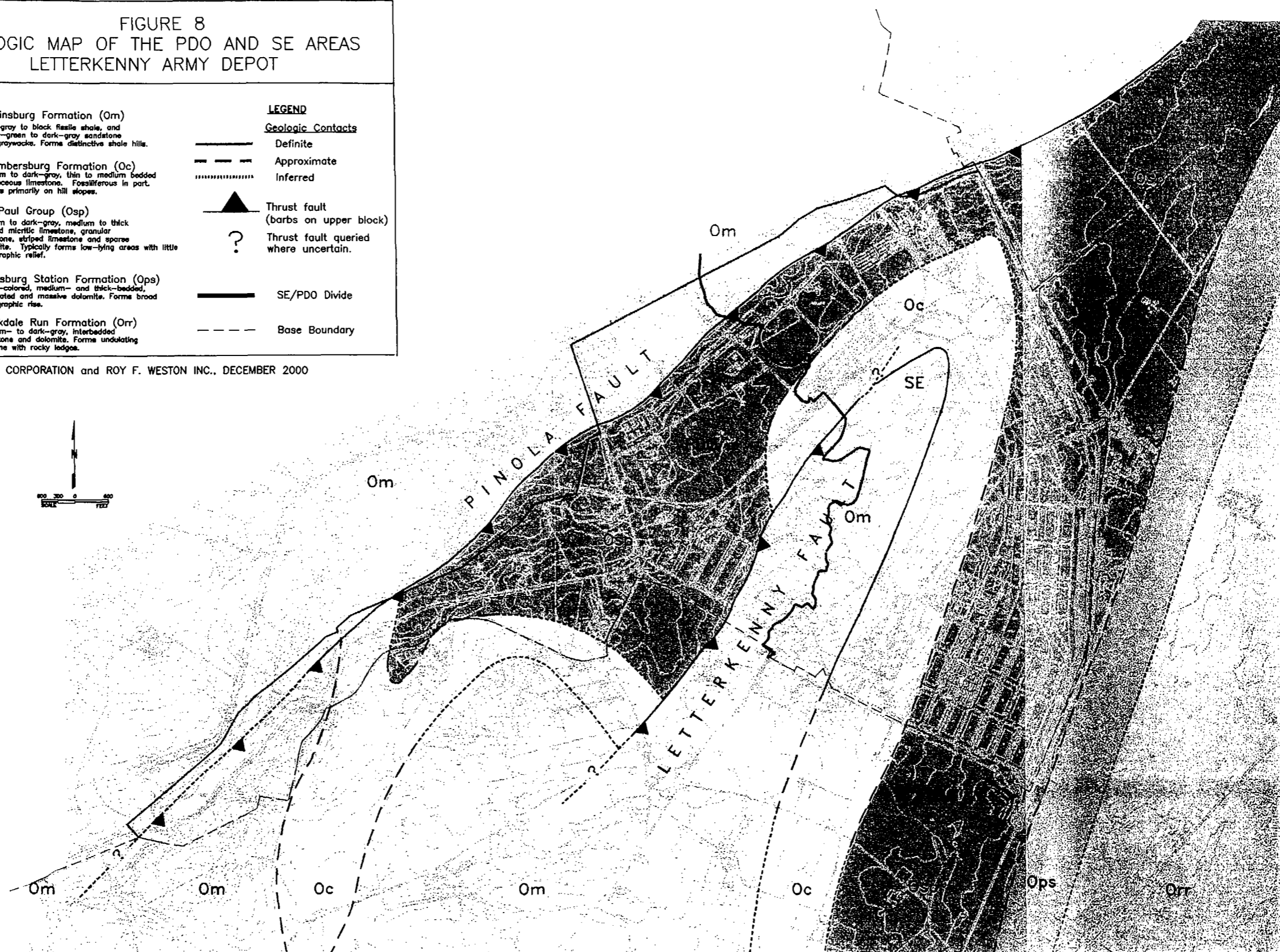
**FIGURE 7**  
**GENERAL SOIL MAP: FRANKLIN**  
**COUNTY, PENNSYLVANIA**

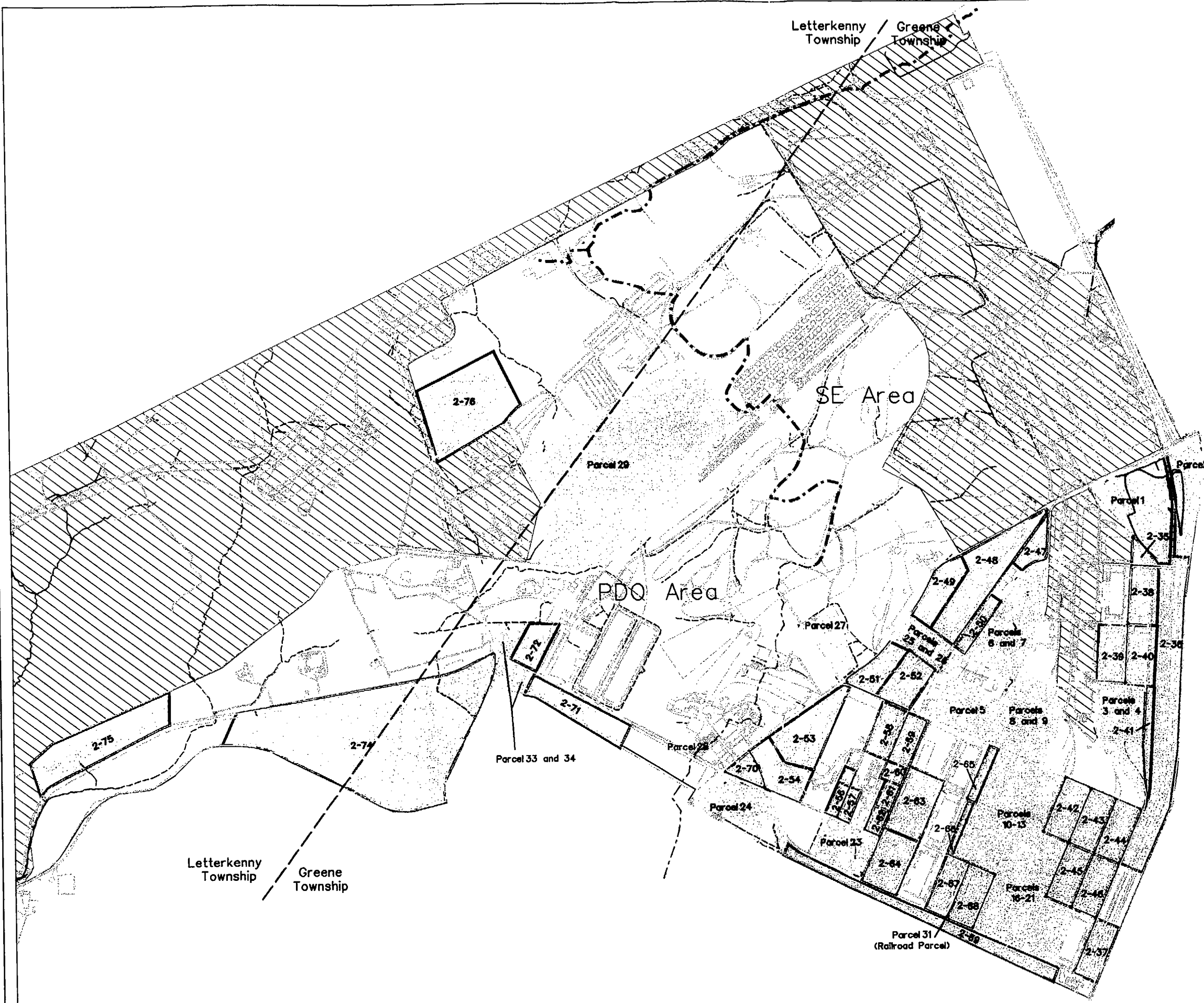
Source: USDA, 1974; ESE.

FIGURE 8  
GEOLOGIC MAP OF THE PDO AND SE AREAS  
LETTERKENNY ARMY DEPOT











SOURCE: IT CORPORATION and ROY F. WESTON INC., DECEMBER 2000





# LEGEND:

-  Buildings
-  Roads
-  Enclave Area
-  Phase I Transfer Area
-  Phase II Transfer Area
-  Parcel ID
-  Drainage Divide
-  Township Line

## Note:

All Parcels to be Transferred for Commercial/Industrial Reuse Except as Follows:

- Parcel 33 - Community/Daycare
- Parcel 2-74 - Community
- Parcel 2-75 - Residential

0 600 1200 1800 2400  
Feet



## Letterkenny Army Depot Chambersburg, PA

Figure 9  
Location of Phase I and Phase II  
Parcels at LEAD



U.S. Army Corps of Engineers  
Baltimore District



WESTON  
DESIGN/CONSTRUCTION

Revision • Date:  
10-01-2001

FSWC6:proj5\letter\mapping\n27\phaseII\phaseIand2.dgn

# Appendix A

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**APPENDIX A**

**INTERVIEW SUMMARY**

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## APPENDIX A

### INTERVIEW SUMMARY

**Personnel Interviewed:** Joseph Petrasek, LEAD ERA, Project Manager

**Interviewer:** Paul R. Stone III, Design Manager, CENAB-EN-HM

**Date:** 1 August 2001

**Location:** LEAD

1. To date what sort of maintenance has been performed on the capped K Areas?

Routine mowing. The capped areas (K-1, K-2, and K-3) are included in the Depot's mowing and landscape plan. The last few years this work has been performed by contractors.

2. To date what sort of inspections have been performed on the capped K Areas?

In 1995 the USAEC Project Manager (performs technical environmental work for the Depot) inspected the capped areas with the Contractor performing the SE OU 3 FFS effort prior to the installation of monitoring wells.

From 1996 to 2001 the USACE Design Manager inspected the capped areas with the SE OU 3 FFS contractor as part of additional FFS efforts.

3. Was there damage to the capped areas?

No, some of these monitoring wells were installed close to the capped sites. In addition, drilling rigs and support vehicles were operated close to these sites. No permanent damage was caused to the site.

4. Are there problems with groundhog burrows?

The groundwater is very close to the surface at K-1. The groundhogs tend to live in the ore piles where they can stay dry. The 2001 inspection identified evidence of groundhog burrowing in K-1 and K-2.

5. Have there been changes to the capped areas?

Yes, in the winter of 1996-1997 LEAD allowed the Navy to install monitoring wells near K-1 as part of a test of High Resolution Three Dimensional Seismic. Several wells were installed on the toe of the cap (soil cover that slopes to grade). None of these wells penetrated the cap liner. LEAD had notified PADEP and received their approval for this action.

In the summer of 1999 the Army performed an In-Situ H<sub>2</sub>O<sub>2</sub> Bedrock Injection Pilot Study at K-1. To perform this study the Army had to breach the liner. The Army hand excavated the soil

until the Geotextile, membrane, and liner were exposed. These were hand cut to expose the underlying soil cover. Boards were placed over the cap to distribute the drilling rigs weight over a wider area. Once the wells were installed, “boots” were placed over the wells and attached to the casing. The bottom of the boot was then solvent welded to the liner, then recovered.

6. After the pilot study was completed was the site restored?

The summer of 1999 was a drought year. Restoration efforts would have been futile. Site vegetation restored naturally in Spring 2001.

7. Was the K Areas Remediation successful?

It was since the soil source was removed and treated. It had no immediate impact on groundwater quality, as the majority of the VOC source is in the bedrock.

8. How is the K Areas groundwater being addressed?

It is being addressed by SE OU 3 (Disposal Area VOC-Contaminated Groundwater).

## **Appendix B**

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**APPENDIX B**

**REPORT ON 225 PPB SOIL REMOVAL ACTION LEVEL**

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## APPENDIX B

### REPORT ON 225 PPB SOIL REMOVAL ACTION LEVEL

#### LETTERKENNY ARMY DEPOT SOUTHEASTERN AREA OPERABLE UNIT ONE (K AREAS) FIVE YEAR REVIEW

**Question One: Why was 225 ppb selected as the soil removal action level? How was it documented?**

#### **Background History:**

The Record of Decision (ROD) for the Accelerated Remedial Action Southeastern Area Operable Unit One: K Area Contaminated Soils was signed by the United States Army (Army) on 28 June 1991.

An Explanation of Significant Differences (ESD) was signed by the Army on 31 July 1991 and the EPA on 02 August 1991. The ESD stated that the appropriate ARARs for any metals found in soils during the remediation at the SE Area was the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. § 5901 et seq., Land Disposal Restrictions promulgated at 40 C.F.R. Part 268.

These two documents constitute the ROD for this effort.

The ROD (27 June 1991) on page two identified the major components of the planned K Areas Remedial Action as:

- Excavation of 8,000 cubic yards of contaminated soils in the K Area.
- Thermal treatment of contaminated soils at a temperature not greater than 450 °F.
- Destruction of volatilized contaminants by a secondary high-temperature combustor or adsorption of volatilized contaminants onto activated carbon.
- Analysis of representative samples of treated soils and comparison with treatment criteria.
- Proper management of treated soils.

**Documents:****Endangerment Assessment of the Southeastern Area at Letterkenny Army Depot, September 1988, Final**

The Endangerment Assessment (EA) used two Remedial Investigation Reports to document the site conditions at the DA:

Remedial Investigation/Feasibility Study of LEAD (SIA/Disposal Area), Weston, 1984. Values for VOCs in soil and groundwater in the DA from this effort are found in Table 3.3-5.

Remedial Investigation of the Disposal Area (SIA) ESE 1986. Table 3.3-7 (page 3-22) listed the following values for soil and groundwater contamination in the DA:

**Table 3.3-5. Contaminants Found Above Detection Limits in the Soils and Groundwater of Area K-1 in the DA**

Contaminant	Concentration	
	Soil (µg/kg)	Groundwater (µg/L)
<b>Organics</b>		
Chloroform (CHCL <sub>3</sub> )	200	40
1,1-Dichloroethylene (1,1-DCE)	3,000	400
trans-1,2-Dichloroethylene (TI2DCE)	50,000 – 2,000,000	90,000
Methylene Chloride (CH <sub>2</sub> CL <sub>2</sub> )	800 – 10,000	30
Tetrachloroethylene (TCLEE)	200 – 800,000	
Trichloroethylene (TCE)	300 – 500,000	10,000
<b>Metals</b>		
Arsenic (As)	6,800	—
Cadmium (Cd)	10,800 – 24,800	

Note: DA = Disposal Area.

µg/kg = micrograms per kilogram.

µg/L = micrograms per liter.

— = no data.

Source: Weston, 1984.

**Table 3.3-7. Contaminants Found Above Detection Limits in the Soils and Groundwater of Area K-1 in the DA**

Contaminant	Concentration	
	Soils (µg/kg)	Groundwater (µg/L)
<b>Organics</b>		
Benzene	100-700 (3)	30 (1)
Chlorobenzene	600 (1)	
Chloroform	200 (1)	40 (1)
1,1-Dichloroethene	3,000 (1)	400 (1)
cis/trans-1,2-Dichloroethene	50,000-2,000,000 (7)	90,000 (1)
Dichloropropane	10,000 (1)	
Ethylbenzene	9,000-10,000 (2)	50 (1)
Ethylmethylbenzene	3,000 (1)	
Methylene chloride	800-10,000 (5)	30 (1)
1,1,2,2-Tetrachloroethene	200-800,000 (7)	5,000 (1)
Toluene	1,000-100,000 (5)	20 (1)
Trichloroethylene	300-500,000 (7)	10,000 (1)
Trimethylbenzene	2,000-30,000 (2)	
Various hydrocarbons	2,000-400,000 (3)	
Vinyl chloride	5,000-200,000 (3)	10,000 (1)
xylene	1,000-700,000 (5)	
<b>Inorganics</b>		
Arsenic	6,800 (1)	
Barium	108,000-235,000 (3)	
Cadmium	10,800-24,800 (3)	
Chromium (total)	25,800-150,000 (3)	
Copper	53,500-156,000 (3)	
Cyanide	<10,000 (3)	
Lead	44,100-3,390,000 (3)	
Mercury	700 (1)	
Sulfide	<10,000->10,000 (3)	
Zinc	115,000-1,360,000 (3)	

\* ( ) - Number of positive responses.

Sources: Weston, 1984.  
ESE, 1985b.

The exposure assessment and risk characterization of the EA determined that consumption of home-produced vegetables was the only exposure pathway where the estimated risks exceed the CERCLA 10<sup>-6</sup> target risk level.

Page 6-10 of the EA states that: *“Results of the RA for use of the offpost groundwater indicate that risks associated with consumption of home-produced vegetables is the only exposure pathway where the estimated risks exceed the 10<sup>-6</sup> target risk level (i.e., with a total estimated risk of  $6.57 \times 10^{-6}$ ). ARARs developed for drinking water are not appropriate for exposure through the vegetable-consumption pathway. Therefore, the development of criteria based on the RA would be more appropriate.”*

#### **Risk Based Exposure Calculation Groundwater (Offpost):**

The EA stated that since consumption of water contained in vegetables was a very small percentage of total water consumption; the ARAR for Offpost groundwater should not be 5 ppb but a number that reflected the actual risk that vegetables posed to Offpost residents. **All homes exceeding the ARAR of 5 ppb of TCE had already been supplied with an alternate water supply.**

Page 6-13 states: *“Using the integrated results of the exposure assessment and risk characterization, the total risk due to consumption of home-produced vegetables in the DA is  $2.90 \times 10^{-6}$  (Table 5.1-17). Since the total risk due to all other pathways is  $3.57 \times 10^{-7}$ , an acceptable risk level for the contaminants in the vegetable-consumption pathway would be  $1.0 \times 10^{-6}$  (all other risk is negligible).*

*Therefore,  $1.0 \times 10^{-6}$  was used as the target CRL for each carcinogen present in groundwater offpost of the DA (two carcinogens present, 1,1-DCE and TCE).*

*Groundwater concentrations for 1,1-DCE and TCE can be calculated by applying the risk characterization equation, as follows:*

$$CRL = CPF \times Dose$$

*where: CRL - cancer risk level ( $1.0 \times 10^{-6}$ ),*

*CPF = cancer potency factor (from Sec. 2.0), and*

$$Dose = \text{vegetable-consumption dose} \frac{0.108 \text{ kg/day} \times F (\text{L/kg}) \times C_w}{70 \text{ kg}}$$

*From this the EA developed a risk-based number reflective of a  $10^{-6}$  excess Offpost Health Risk. The risk-based number was 27.4 ppb for TCE.*

#### **Soil to Groundwater Pathway:**

The soil cleanup level was calculated from the representative soil concentrations chosen for the DA along with groundwater quality data for Wells 81-7, 81-8, and 82-1 (which are located downgradient of the contaminated soils and along the installation boundary).

The first step in the guideline preparation was to calculate a dilution factor that represents the change in concentrations from soils to groundwater at the boundary.

This dilution factor was then used to back-calculate an acceptable soil concentration starting with an acceptable groundwater concentration at the receptors.

The dilution factor was assumed to be a linear relationship that implicitly accounts for parameters such as adsorption, groundwater mixing, and groundwater diffusion because they cannot be quantified explicitly. Rather, the dilution was chosen as the simple ratio between concentrations observed in soil and concentrations observed in the wells. This simplistic approach may underestimate the dilution ratio and result in an overly conservative soil cleanup guideline. For example, groundwater contamination observed now at the boundary may have been generated as a leachate at a time in the past when soil concentrations may have been substantially higher than they are now.

Two compounds, 1,1-DCE and TCE, were identified in the EA as critical contaminants offpost of the DA (Sec. 6.2) and were used to develop soil criteria for the DA. Other compounds found in DA soils or groundwater were not chosen because they were not found to be of concern at the receptor point.

The representative concentrations in soil and groundwater are presented in Table 6.3-1. The groundwater concentrations were chosen as the maximum observed in any of the three wells (81-7, 81-8, or 82-1). The ratios of soil to groundwater concentrations were found to be 1 for 1,1-DCE and 45 for TCE.

The EA divided the representative soil concentration (4,900 µg/kg) by the average groundwater standard at the boundary (average of the DCE and TCE content from wells 81-7, 81-8, and 82-1) to lead to a dilution/partitioning factor of 45. The number 45 was then multiplied by 27.4 (risk-based standard) to end up with 1,230 ppb.

**Feasibility Study of the Southeastern Area at Letterkenny Army Depot First Operable Unit, Final Report, September 1988:** This report contained the same TCE removal value as the EA.

**Focused Feasibility Study of the Accelerated Remedial Actions at Letterkenny Army Depot, Final Report, August 1990:** This report states that further discussions with EPA Region III and Pennsylvania Department of Environmental Resources indicated that the groundwater must be considered a potential drinking water source and associated risk levels and cleanup criteria must take into consideration an average adult groundwater consumption rate of 2 liters per day. Based on this consumption rate the maximum groundwater contamination level for TCE was recalculated to be 3 µg/L, which is below the state ARAR of 5 µg/L (Table 1.4-3). Using 5 µg/L as the groundwater standard for TCE, a soils cleanup level was estimated to be 235\* µg/kg. The average concentration of TCE in the DA soils is 4,900 µg/kg, which exceeds the calculated soil criterion. Thus, cleanup of the soil in the DA to the acceptable soil concentration of 235\* µg/kg is expected to result in acceptable groundwater concentrations for offpost receptors.

---

\* Note number in error.  $45 \times 5 = 225$  not 235.

Table 6.3-1. Soil Cleanup Criteria Calculations

Compound	Acceptable Groundwater Criteria (µg/L)	Representative Soil Concentration (µg/kg)	Groundwater Concentration* (µg/L)	Dilution	Soil Cleanup Criteria (µg/kg)
1,1-Dichloroethylene (1,1-DCE)	0.72	2.0	1.83	1	+
Trichloroethylene (TCE)	27.4	4,900	109	45	1,230

\*Maximum observed in Wells 87-1, 81-8, and 82-1, sampled spring 1987 (ESE, 1987b).

+No cleanup criteria given; 1,1-DCE assumed to be a breakdown product of TCE in soil and groundwater.

Source: ESE, 1988a.

**Table 2.2-3 Cleanup Criteria for the SE Area Soils**

Compound	Acceptable Groundwater Criteria (µg/L)	Representative Soil Concentration	Groundwater Concentration <sup>a</sup> (µg/L)	Dilution	Soil Cleanup Criteria (µg/kg)
1,1-DCE	0.94	2.0	1.83	1	+
TCE	5.0	4,900	109	45	235 <sup>b</sup>

Note: DA = Disposal Area.

1,1-DCE = 1,1-dichloroethylene.

TCE = trichloroethylene.

µg/kg - microgram per kilogram.

µg/L - microgram per liter.

<sup>a</sup>Maximum observed in Wells 87-1, 81-8, and 82-1, sampled spring 1987 (ESE, 1987b).

<sup>b</sup>Note number in error.  $45 \times 5 = 225$  not 235.

+No cleanup criteria given; 1,1-DCE assumed to be a breakdown product of TCE in soil and groundwater.

Source: ESE, 1988b.

**Proposed Plan for the SE Area (FFS), Final September 1990:** In this document, the 235 ppb number has been corrected to 225 ppb.

**Public Meeting Letterkenny Army Depot Proposed Plans, 14 May 1991:** The transcript of this document indicates that the correct value of 225 ppb was used in the presentation.

**Question Two: Is the 225 ppb remedial standard contained in the SE OU 1 ROD protective of the environment?**

The EA (pages 6-17 and 6-18) stated that: A guideline for DA soil cleanup can be estimated through use of available soil and groundwater data with the realization that this guideline has a high degree of uncertainty. The guideline was linked to the soil-to-groundwater pathway instead of other pathways because soil cleanup is not required for contamination transported by other routes. This cleanup criterion is not expected to guarantee that groundwater concentrations will be acceptable at the receptor exposure points because of the level of uncertainty associated with this approach.

Since the EA and ROD were signed it was determined that the K-1 Area was more contaminated than estimated. Up to 5.5% TCE contamination as opposed to 2%.

The groundwater in the DA is also more contaminated than identified in the EA/ROD.

Of the three monitoring wells used in the EA, only in well 82-1 has dye been consistently detected. This calls into question the interconnectivity of the other wells 87-1 and 81-8.

**Updated Soil to Groundwater Pathway information.**

As part of the EE/CA for the Spill Area in Area A (SE OU 5), the Army developed soil removal criteria that would be protective of site groundwater (5 ppb for TCE).

Pennsylvania Act Two Guidance allowed the Army to either use 100 times the MCL, or to use a state-wide standard for groundwater compliance. The calculated value was 171 ppb for TCE.

The Army selected 171 ppb for TCE because it is a more conservative number. Based on these calculations soil containing more than 171 ppb of TCE would cause the underlying groundwater to exceed 5 ppb. This indicates an estimated partitioning coefficient of 34. The EA and FFS had identified a dilution/partitioning factor of 45 for TCE.

It has to be remembered that the ROD value of 225 ppb was to meet ARARs at the LEAD boundary (location of monitoring wells 87-1, 81-8, and 82-1). As such, the ROD value of 45 is a dilution and partitioning factor, while the SE OU 5 EE/CA value of 171 for TCE represents a partitioning coefficient only. Calculations conducted by IT Corporation of Site-Specific Soil Screening Levels for the K-Areas yielded a removal standard of 780 ppb (see Appendix A).

Another factor to consider: The Removal Areas delineated in the K Areas were delineated to non-detect, not 225. This was done because the Army had no precise number to use and was concerned it would have to go back if later studies determined that 225 ppb was not sufficiently protective.

## APPENDIX B—REPORT ON 225 PPB SOIL REMOVAL ACTION LEVEL

	Compound	Acceptable Groundwater Criteria (µg/L)	Representative Soil Concentration	Groundwater Concentration* (µg/L)	Partition Dilution Factor	Soil Cleanup Criteria (µg/kg)	Point of Compliance
ROD	TCE	5.0	4,900	109	45@*	225	Boundary
SE OU 5 EE/CA Site	TCE	5.0	NA	NA	34@	170!	Site
PADEP ACT 2 100 X	TCE	5.0			100	500!!	Site
SE OU 1 SSL	TCE	5.0			156	780&	Site

@: Partitioning Value

\*: Dilution Value

!: Act Two Statewide Standard

&amp;: (See Appendix A)

!!: Act Two Standard, 100 times MCL

## **Appendix A**

### **Draft Determination of Site-Specific Soil Screening Level (SSL) Letterkenny Army Depot**

28 January 2000  
IT Corporation

## **Determination of Site-Specific Soil Screening Level (SSL) Letterkenny Army Depot**

### ***Summary***

A Soil Screening Level (SSL) of 780 micrograms per kilogram ( $\mu\text{g}/\text{kg}$ ) was calculated for trichloroethene (TCE) in soil using a conceptual site model developed for Area K-1 in the Disposal Area (DA) at the Letterkenny Army Depot. The point of compliance is the groundwater at the K-Areas. This document provides a summary of the conceptual model, the SSL method, and the calculation results.

The SSL was calculated in accordance with the “Soil Screening Level Guidance” developed by USEPA (1996a and 1996b). The SSL was calculated for migration of TCE from the soil matrix to groundwater. The SSL is the estimated soil concentration that will result in an acceptable concentration in groundwater through leaching.

### ***Conceptual Site Model***

Area K-1 was a former solvent disposal lagoon with surface area dimensions of approximately 200 feet in the north-south direction and 100 feet in the east-west direction. In a Removal Action conducted in 1993, TCE-contaminated soils were excavated to the top of bedrock, which is present at a depth of between 20 and 30 feet below ground surface. TCE was removed from the excavated soils using Low Temperature Thermal Treatment, and treated soils were placed back into the excavation. The treatment standard was 0.050 mg/kg. Post-treatment soil sampling and analysis was conducted to demonstrate compliance with the treatment standard.

A karst aquifer is present at the site, which has developed in the limestone bedrock. Remedial investigations indicate the limestone has very little primary intergranular porosity. Secondary porosity has developed by solutioning, and is important for the storage and movement of groundwater. The effective aquifer thickness is approximately 120 feet based on the distribution of solution features measured in borehole logs for the DA. Solution channels are not common below this depth. Borehole logging in the DA indicates the secondary porosity, as the percentage of void space in the bedrock, is approximately 5%.

Groundwater flow is rapid due to the open flow conditions in the solution channels of the aquifer. The average groundwater flow rate was determined to be approximately 280 feet per day (ft/day) from dye tracer studies in the DA.

### ***SSL Calculation Method***

The following is a description of the SSL calculation method as summarized from the Soil Screening Guidance (USEPA 1996a).

As soil leachate moves through soil and groundwater, contaminant concentrations are attenuated by adsorption and degradation. In the aquifer, dilution by clean ground water further reduces concentrations before contaminants reach receptor points (i.e., drinking water wells downgradient of the LEAD boundary). This reduction in concentration can be expressed by a dilution attenuation factor (DAF), defined as the ratio of soil leachate concentration to receptor

point concentration. The Soil Screening Guidance addresses only one of the dilution-attenuation processes: contaminant dilution in ground water. Attenuation by adsorption and degradation are not included in this model.

A simple mixing zone equation is derived from a water-balance relationship, and is used to calculate a site-specific dilution factor. The dilution factor is determined by estimating the volume of leachate infiltrating through the soil via precipitation, and comparing the infiltration to the volume of groundwater flowing beneath the site.

The SSL is calculated as follows. First, a mixing-zone depth is calculated based on site-specific hydrogeologic conditions including aquifer thickness, hydraulic gradient, and hydraulic conductivity (Equation 1). As shown in Equation 1, mixing beneath Area K-1 is estimated by this calculation to be in the upper 11 feet of the aquifer. Next, a dilution factor is calculated based on the estimated rate of infiltration and the flow of groundwater (Equation 2). Chemical-specific characteristics are then used to determine the chemical-specific SSLs. The ground water standard (i.e., MCL) is multiplied by the dilution factor to obtain a target soil leachate concentration. Finally, the partition equation is used to calculate the total soil concentration corresponding to this soil leachate concentration. As shown in Table 3, the SSL calculated using this method is 0.780 mg/kg or 780 µg/kg.

The SSL calculation method assumes the exposure point is immediately downgradient of the waste disposal unit. Further dilution occurs as the contamination moves downgradient, however, and the above method does not account for the dilution as groundwater flows away from the unit.

### ***References***

USEPA, 1996a. Soil Screening Guidance: Users Guide. EPA/540/R-96/018.

USEPA, 1996b. Soil Screening Guidance: Technical Background Document. EPA/540/R-95/128.

Table 1

## Estimation of Mixing Zone Depth

$$\text{Equation 1: } d = [0.0112 * L * L]^{1/2} + b \{ 1 - \exp [ (- L * I) / (K * I * b) ] \}$$

Parameter	Value	Reference
L = source length parallel to groundwater flow (ft)	100 ft	East-west dimension of Area K-1
I = infiltration rate (ft/day)	0.0046 ft/day	Assumed to be 50% of total annual rainfall of 40 inches
k = aquifer hydraulic conductivity (ft/day)	3,100 ft/day	From Darcy's Law, $K = n * v / i$
i = hydraulic gradient (ft/ft)	0.0045 ft/day	Average hydraulic gradient from DA to Rowe Spring
b = aquifer thickness (ft)	120 ft	Effective thickness based on geophysical logging in the DA
v = groundwater velocity	280 ft/day	Velocity obtained from dye trace studies in the DA
d = mixing zone depth (ft)	11 ft	Calculated from Equation 1

**Table 2**  
**Derivation of Dilution Factor**

Equation 2:  $DF = 1 + [k \cdot I \cdot d / I \cdot L]$

Parameter	Value	Reference
k = aquifer hydraulic conductivity (ft/day)	3,100 ft/day	From Darcy's Law, $k = n \cdot v / i$
i = hydraulic gradient (ft/ft)	0.0045	Average gradient from DA to Rowe Spring
I = infiltration rate (ft/day)	0.0046 ft/day	Assumed to be 50% of total annual rainfall of 40 inches
d = mixing zone depth (ft)	11 ft	Calculated from Equation 1
L = source length parallel to ground water flow	100 ft	East-west dimension of Area K-1
n = aquifer porosity	0.05	Average secondary porosity observed in boreholes drilled in DA
DF = dilution factor based on water —balance relationship	330	Calculated from Equation 2

Table 3

## Soil Screening Level Partitioning Equation for Migration to Groundwater

Equation 3:  $SSL \text{ (mg/kg)} = C_w \{ K_d + [(O_w + O_a * H') / P_b] \}$ 

Parameter	Value	Reference
DF = dilution factor derived from water balance relationship	330	Calculated from Equation 2
MCL = Maximum Contaminant Level (mg/L)	0.005 mg/L	USEPA 1996a, MCL for TCE
$C_w$ = target soil leachate concentration (mg/L)	1.6 mg/L	$MCL * DF$
$K_d$ = soil water partition coefficient (L/kg) = $K_{oc} * f_{oc}$	0.19 L/kg	$K_{oc} * f_{oc}$
$K_{oc}$ = soil organic carbon/water partition coefficient (L/kg)	94 L/kg	USEPA 1996b, Table 38 value for TCE
$f_{oc}$ = fraction organic carbon (g/g)	0.002	USEPA 1996a, default value
$O_w$ = water-filled soil porosity	0.30	USEPA 1996a, default value
$O_a$ = air-filled soil porosity	0.0	USEPA 1996a, assumed saturated with water
$P_b$ = dry soil bulk density (kg/L)	1.5	USEPA 1996a, default value
$H'$ = Henry's Law constant (dimensionless)	0.42	USEPA 1996b, Table 36 value for TCE
SSL = Soil Screening Level, site-specific for TCE	0.780 mg/kg or 780 µg/kg	Calculated from Equation 3